NEW ZEALAND
JOURNAL OF
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JULY - 1952

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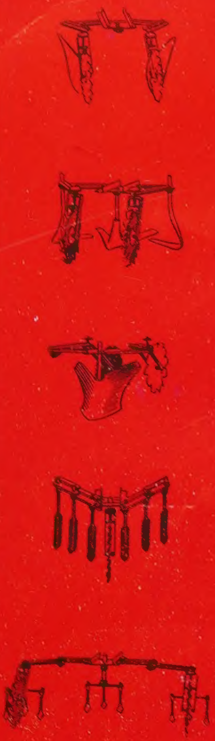

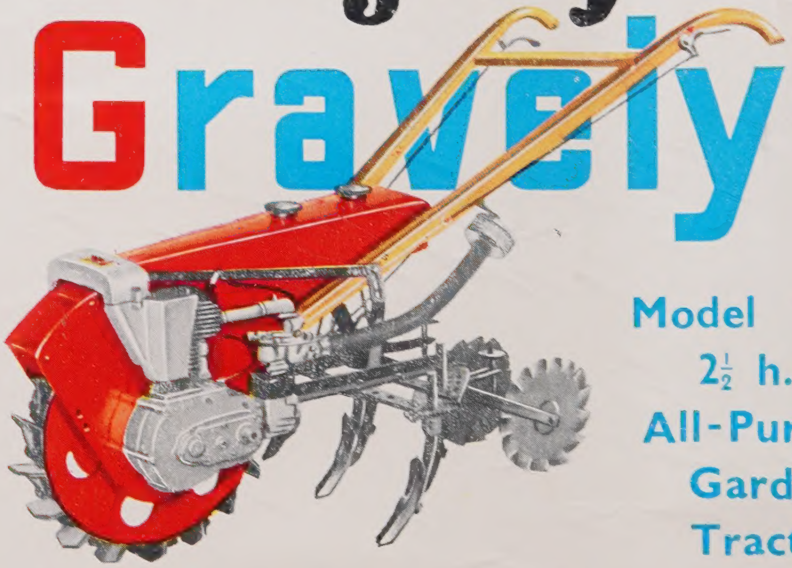

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This Month's Cover

There has been considerable expansion in the growing of sub-tropical fruit in New Zealand, with the result that in recent years a greater range of locally grown fresh fruit has been available. This month's cover, which has been reproduced from a Flexichrome (Kodak (N.Z.) Ltd.) print by L. Cutten from a photograph by Sparrow Industrial Pictures Ltd., shows passion fruit and persimmons, sub-tropical fruits which ripen from February to April. The former have been popular for many years and the latter will probably be appreciated more widely as they become better known.

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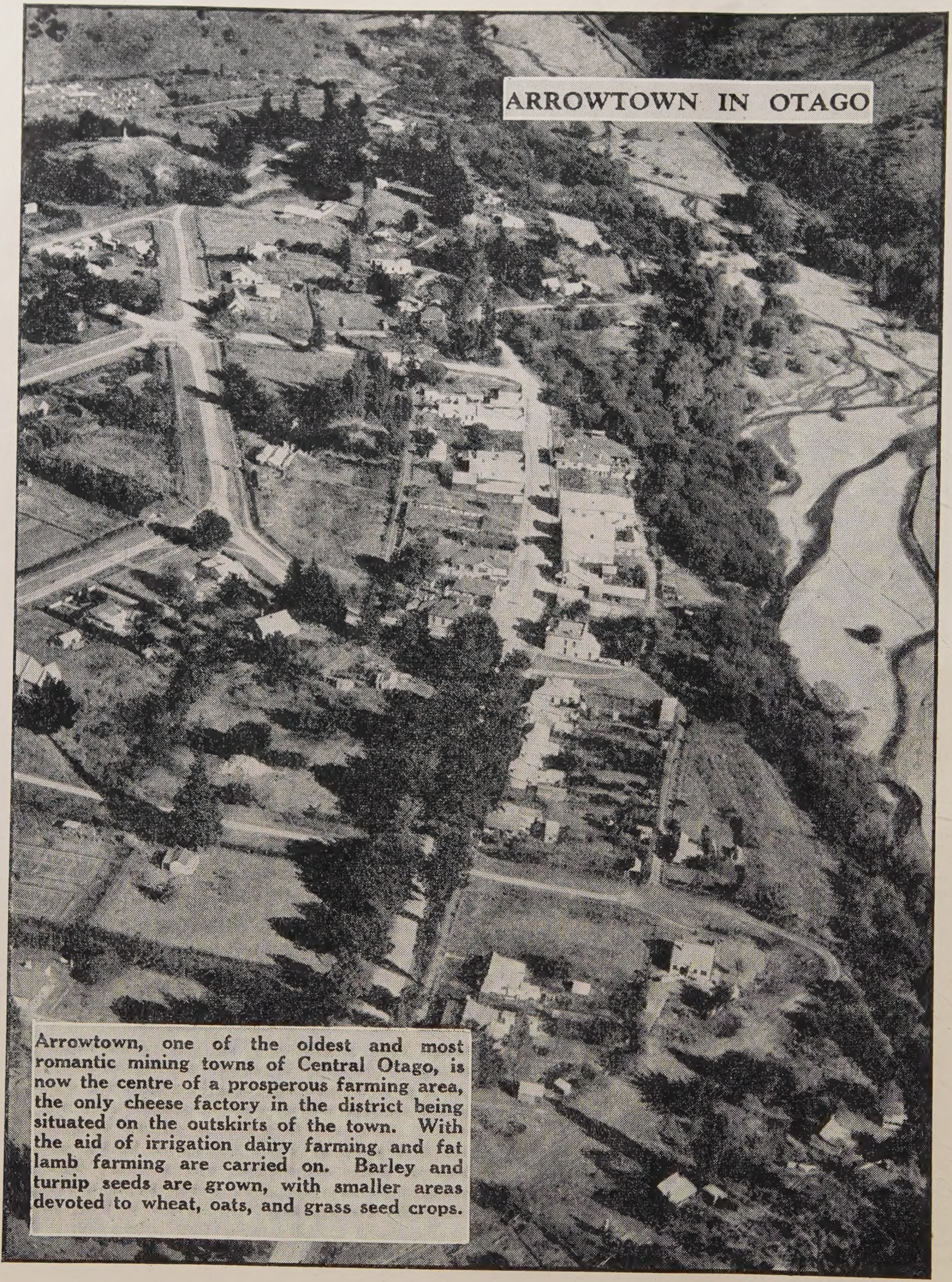


ARROWTOWN IN OTAGO

Arrowtown, one of the oldest and most romantic mining towns of Central Otago, is now the centre of a prosperous farming area, the only cheese factory in the district being situated on the outskirts of the town. With the aid of irrigation dairy farming and fat lamb farming are carried on. Barley and turnip seeds are grown, with smaller areas devoted to wheat, oats, and grass seed crops.

W. O. Browne photo.

More Produce from Home Vegetable Gardens

WITH the steady increase in population in New Zealand each year the demand for fresh vegetables must expand. Unfortunately expansion of the population of towns and cities has often resulted in land previously used for market gardening being taken for housing and sometimes industry, so that the rise in population is doubly felt. The loss of good vegetable land close to city markets has pushed production further afield and has increased marketing problems and costs; yet it seems more logical for vegetable production to go further afield than to force city workers to live far from places of employment and so increase their daily travel costs.

Despite a slight increase in the number of registered market gardeners and in the area in vegetable crops, there has been a decrease in over-all production. The unfavourable spring and the difficulties faced by commercial gardeners in securing adequate labour and supplies of fertilisers have contributed to the fall in production. A very real measure of relief for recurrent shortages of vegetables, such as occurred last spring, and recently with potatoes, can be provided by home gardeners. I am appealing to all who have available ground to make the most of it. I am satisfied that there are factors which make it difficult at present for the market gardening industry and, on occasions, the potato growers to provide vegetables for cities and towns to the full extent to which they are needed. Much idle criticism has been levelled at growers and distributors for past shortages, but the situation may be considerably eased by householders helping themselves by growing more and better crops in kitchen gardens.

Satisfaction in Successful Gardening

There is much satisfaction in successful gardening, whether the result is purely decorative or whether it represents a saving of shillings and a healthier diet. Few New Zealanders who live in cities and towns are more than two generations removed from life on the land, and consequently most derive satisfaction from tilling the soil, however small or stubborn their plot may be. Anyone who applies himself intelligently can make a success of a vegetable garden. To the tyro there is available today a much greater fund of knowledge of cultural practices than there was even 20 years ago. There is a regular feature in this "Journal", there are the Department of Agriculture's comprehensive home garden bulletin and other books, there are many excellent articles in magazines and newspapers, and there are the sessions provided by radio stations throughout New Zealand. Added to this is the research being done continually, results of which are incorporated in advice given by field officers.

The advice which is freely available from articles and the radio, if given the attention it deserves, should enable home gardeners to work to much better advantage.

Value of Home Garden Production

I am satisfied that even a moderate increase in the production from each home garden would mean a tremendous amount to over-all production, and higher output in any worthwhile field, particularly at this time, can have a profound effect on our standard of living. We are pledged to increase production of those foods which are staple items for our British customers—meat, butter, and cheese. It would be unreasonable, therefore, to look for greater production of a commodity such as vegetables if this were to be secured by diverting labour to that industry from the already inadequate ranks of general farm workers. Nor is expansion of vegetable growing by farmers whose chief business is production of export items to be advocated. In fact it would be beneficial if some of the effort required to produce domestic needs could be diverted to activities which enabled us to increase our overseas earnings.

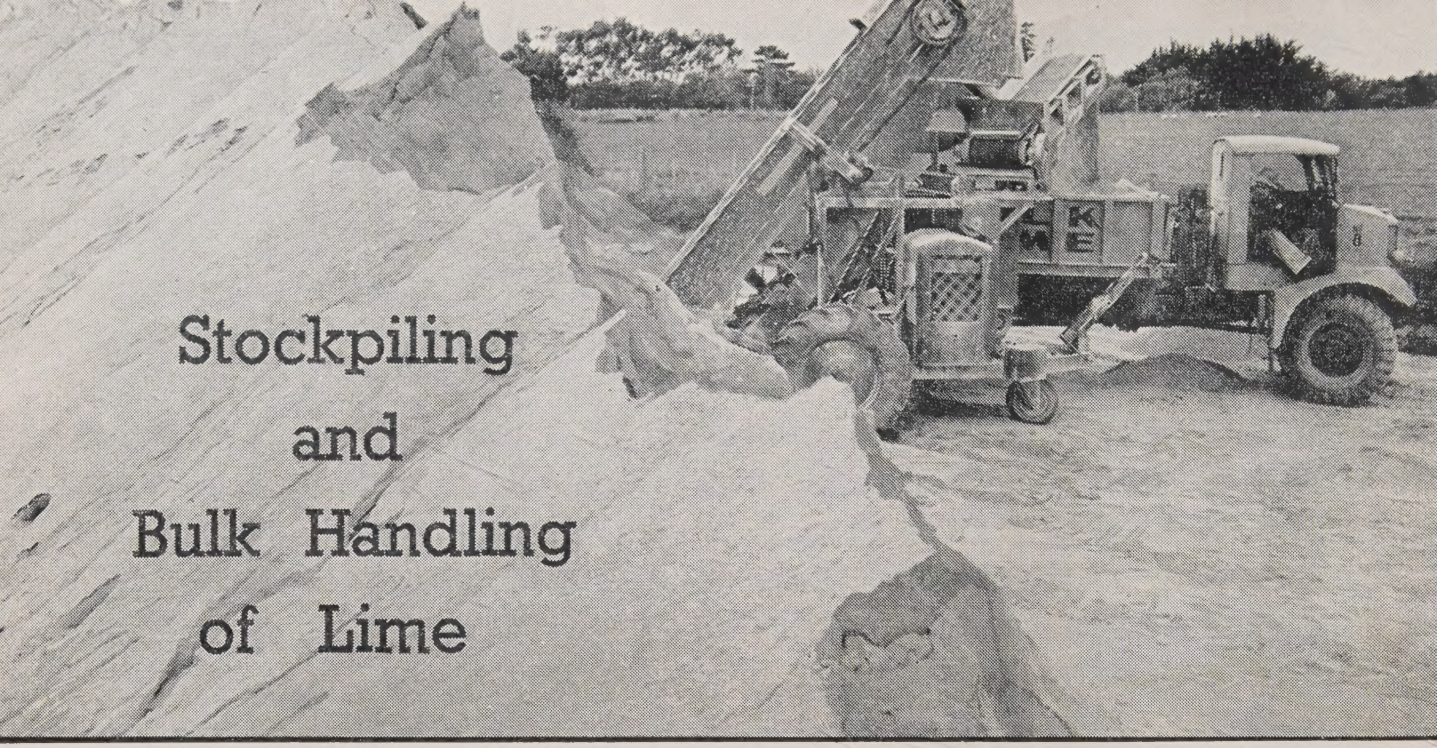
Market gardeners, like other primary producers, have eagerly adopted mechanisation to alleviate labour shortages and to increase their efficiency. Their efforts have been supported by distributors who have broadened the scope of markets by undertaking quick freezing and canning of vegetables, both of which have helped materially in recent years to meet consumers' needs. Commercial growers have little cause to fear over-production; on the contrary there is an urgent need for householders to grow a substantial portion of the vegetables they need to supplement the efforts of the commercial gardeners to keep pace with demands of rising urban populations.

There has been a tendency for home gardening to be selective or seasonal; no great effort is needed to produce some types of vegetables or to produce others during a favourable part of the year. The home garden that is of the greatest value is that which supplies some produce at all seasons.

Such production does not necessarily involve a great deal more work on the whole, but it is here that the advice of the expert needs to be heeded most carefully. Plant breeders have done much to ease the problem associated with all-the-year-round vegetable production, and a very wide range of vegetables suitable for particular conditions is now available. Intelligent use of them will do much to solve the difficulties of maintaining a continuity of supply, the hallmark of the good gardener.

Many of us in sedentary occupations can get valuable exercise from our gardening; there will also be a dividend, personal and national, and that unique satisfaction which one gains from growing something.

K. J. HOLYOAKE, Minister of Agriculture



Stockpiling and Bulk Handling of Lime

By L. C. SCOTT, Advisory Officer, Department of Agriculture, Wellington

FOR many years farmers looking to the railways for their lime deliveries have frequently found that rail wagons were not available when they required them. Priority in rail transport must be given to goods inward from and outward for overseas ships. There are times when coal, timber, and other heavy goods must be moved notwithstanding the urgency of farmers' needs for fertiliser and lime. Although these fertilisers are essential to steady increases in primary production, the availability of rolling stock to deliver them is often influenced by the priority goods already mentioned as well as by movement of the more perishable goods which farmers themselves produce. Extension of stockpiling and bulk handling of lime offer the only means of substantial alleviation of lime delivery problems.

UNTIL the last few years lime meant to farmers dry lime in bags; today it means that only to some. Others use it in bulk (unbagged) and increasing numbers of them are using damp or wet lime, to which the term "green lime" is applied in this article. To some, green lime means lime which has not been dried; to others it means dried lime which has been allowed to become damp or wet.

Green lime offers the greatest possibilities to farmers whose operations in the past have been retarded by delays in rail delivery of their lime. There are also advantages for lime producers and those who deliver and spread it. Production of lime in some places has been governed by the tonnages on order from time to time. Many of these producers of lime have complained, sometimes bitterly, of output losses occasioned by lack of rail wagons for the dispatch of accumulating autumn orders, these unfulfilled orders being cancelled as soon as winter weather sets in. All but a few works can now produce lime fairly steadily throughout the year, provided those concerned make arrangements early for some of it to be stockpiled.

Wet-lime Spreaders Satisfactory

In the December 1950 issue of the "Journal" the advantages of stockpiling lime were referred to, and one of its problems was said to be that few of the spreading units then in use could handle damp or wet lime. Today there are several types of spreaders which do this work efficiently and units of each type are readily available.

Farmers are now using about 1,300,000 tons of lime annually, but 2,000,000 tons is regarded as a conservative estimate of probable annual usage before the next decade passes. Some of this lime will always be required in bags, but it is not thought that the tonnages so dispatched will increase much. It is expected that the increased tonnages will comprise lime handled in bulk.

Transport and Spreading

The cheapest form of bulk supply is usually direct from limeworks to farm by road, provided the distance does not exceed 20 miles. The lime can be transported in either flat-top, hopper-top, or tip lorries, and in some cases these vehicles can be used to spread it. The operations of dual-purpose (delivery and spreading) vehicles are not always economic.

Where delivery distances range from 10 to 20 miles the time required for loading and spreading is on average only about one fifth of that for delivery from works to farm. Except where areas to be dressed are flat and firm, spreading vehicles should be heavily shod to avoid damaging the land. Four-wheel drive and 6-wheel drive lorries give better service on rolling and most other classes of country. They are not often necessary for delivery, though they may have advantages for this work if used in association with trailers.

If lime is spread at the rate of 1 ton per acre, distances travelled in spreading 4-ton loads are only about one twentieth of those travelled in delivering to farms between 10 and 20 miles from the lime supply sources. The effects on tyres when a vehicle is used for both delivery and spreading are very severe. The wear and tear on other parts of the vehicle will not be in the same ratio, but delivery service will materially reduce the period over which the vehicle will be capable of rendering efficient spreading service. Thus there are sound reasons for separation of delivery and spreading operations, and it is only when delivery distances are short that this separation may not be warranted. In fact lime is dumped within a mile or two of its supply source sometimes because it is cheaper to reload it from the ground than to transfer it from one vehicle to another or to run the spreading units to and from the works or stockpile.

Vehicles used exclusively for lime spreading or other work on farms are eligible for E plates and benzine rebates. These savings warrant consideration, but the savings in time and through eliminating extensive road running by expensively shod vehicles are even more important.

More Railed Lime Should be Stockpiled

The volume of lime delivered by rail in recent years has decreased. In the year ended 31 March 1949, 707,584 tons were railed. In the following 2 years the railed

Heading photograph by Sparrow Industrial Pictures Ltd.

supplies of each year were about 660,000 tons. Rail difficulties attributable to the waterfront strike affected rail deliveries in 1952 and the volume fell to 560,000 tons. With increasing interest being shown in the stockpiling of railed lime, and even though it is not expected that rail services will be adequate for all requirements, it is probable that the amount of lime railed in 1953 will reach 700,000 tons. In both islands a substantial proportion of this tonnage will be bulk lime. The North Island bulk figures will exceed 50 per cent. of the total (estimated at 220,000 tons) and over 60,000 tons of that lime will be stockpiled at rail destination points. The South Island bulk figures may be no more than 15 to 20 per cent. of the total (estimated at 480,000 tons) and it is uncertain what quantity will be stockpiled at rail destination points.

Box spreaders fed with bagged lime are operating very satisfactorily and economically in the South Island, and the availability of rail wagons for lime there is better than in the North Island though still not sufficiently good to warrant the slow progress of stockpiling at rail destination points. The 1953 estimate of 480,000 tons to be carried by rail in the South Island is not likely to be reached if the tonnages stockpiled do not approach, say, 10 per cent. of that figure.

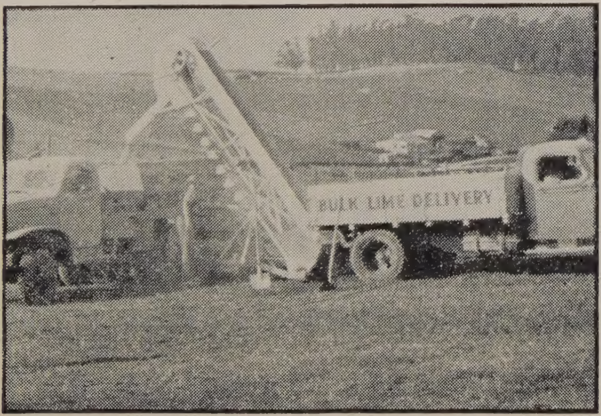
Lime producers cannot afford to ignore the possibilities of stockpiling at rail destination points. The most acute shortages of rail wagons for lime usually occur when there are heavy demands for movements of farmers' outgoing produce and goods from overseas ships. Even when lime starts to move freely by rail the unloading of it from wagons is often delayed because carriers are not always able immediately to switch their services over to lime, dry bulk lime particularly, because of the problems of handling it.

There is a place for railed dry bulk lime, but those in a position to handle bulk lime wet or dry have fewer problems. The man who has no need to worry if the lime is wet or gets wet can unload his rail wagons more freely.

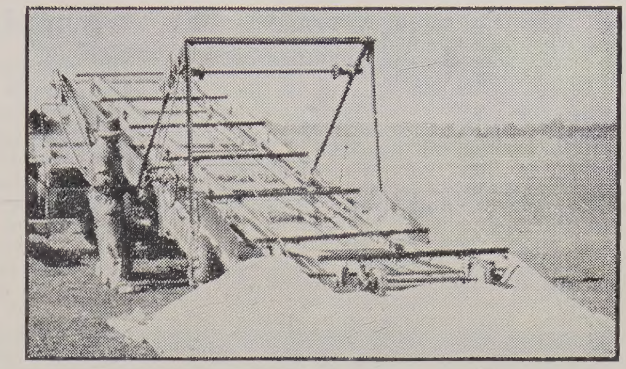
Loading and Unloading Practices

Bulk lime from rail wagons is unloaded into vehicles and stockpiles in various ways. Many of the methods and machines could be improved, but on the whole the work is being done fairly rapidly and at costs which compare favourably with those which bagged lime entails. In the main bulk lime is moved from rail wagons by scraper conveyers or man-handled shovels attached to automatic winches, but some crane grabs are used and in one case a screw conveyer is working very efficiently. This last-mentioned unit is rather costly and therefore is suitable only where tonnages to be unloaded are substantial (10,000 and upward per annum). Except where crane grabs are used, the lime flows from the rail wagons into small V-shaped hoppers and thence by bucket elevators or belt conveyers, sometimes by a combination of both, to vehicles or stockpiles.

Loadings from stockpiles are performed with bucket elevators, front-end loaders, crane grabs, etc. Usually mobility in them is desirable, and those which load from stockpiles at rail points or dumps elsewhere (mainly on farms) according to daily requirements have distinct advantages, especially if the loading rates approach 1 ton per minute.



Bulk lime being transferred from delivery truck to spreader, a desirable system for short distances.



A type of field loader for bulk lime.

Dumping or Transfer

Dumping of lime on farms warrants exploitation. Some facts in support of the separation of delivery and spreading operations have already been given. When these operations are separated lime has to be transferred from one vehicle to another or dumped. If the transfer is direct to the spreader, it may be done from a loading bank if the delivery vehicle is a tip truck, but few suitable loading banks exist. An alternative for direct transfer is a mobile machine of the elevator type. A limiting factor is the number of feeder vehicles required to keep a spreading unit going. This is an excellent method in best circumstances, but generally the right number of feeder units can be arranged only occasionally. Therefore paddock dumping often has advantages, even though it entails another loading instead of a transfer. Tip trucks are preferable for dumping, but not essential. Flat tops can be suitable if they are used in association with a man-handled shovel attached to a mobile automatic winch.

Loading from Dumps

There are problems in loading from dumps. Machines such as crane grabs, front-end loaders, and bucket elevators are all capable of doing this work—some more efficiently than others, depending on volume of lime to be handled and the number of spreading units to be loaded from the dump. Where dumps are relatively close to the paddocks being limed two spreaders may keep loading equipment going, but generally three spreaders are necessary before the loading unit is warranted. Operations on these lines at one place are seldom economic unless 100 tons or more of lime has to be spread. Many of the loaders are operated by the spreader drivers, and although this slows up the spreading rate, the method can be economic and efficient. Costs in these operations vary, but depend on the type of service being given by those delivering and spreading lime.

Cost Factors Important

The farmer bears the costs of handling bulk lime, but only to such extent as the efficiency and competitive interests of those offering that service demand. If the service offered is confined to dry lime, there are limiting factors, such as wet or windy days, which sometimes retard and often destroy the continuity of operations. These factors have costly repercussions and restrict the handling methods, particularly those needed if spreading is being done say 10 to 20 miles from the lime supply source (a limeworks, because stockpiled lime is generally at least damp and sometimes wet). There are fewer limitations if the service offered embraces damp or wet lime.

Those interested in the delivery of damp lime to dumps can do that work at odd times if they wish, provided their organisation of subsequent spreading operations is satisfactory. The work done in this way should have beneficial effects on the overhead expenses of carriers. The deliveries can be made in various types of lorries with or without trailers. For instance, vehicles used for movement of fat stock, grain, etc., can be adapted without much trouble. Carriers can hardly afford to ignore these possibilities for lowering overhead costs.

Handling Costs

Opinions differ on the costs of bulk handling of lime. If costs are based only on standard cartage rates for delivery plus loading from dumps to spreader, they may be as high as, or higher than, those for bagged lime. Competition will ultimately settle this question, but those who do not study the economics of it and organise their operations and charges appropriately may find it difficult to retain their lime-handling connections.

Efficiency Necessary

Delivery and spreading of lime can be handled by carriers in conjunction with their other carrying activities, or carriers can handle the delivery and leave spreading to others (either contractors or farmers). In either event a high standard of organisation is necessary. Those who undertake the whole job have to satisfy only the farmer. Where delivery only is the carrier's job he must study the needs of the spreading operator, which means that lime must be available to the latter at all times required by his farmer clients. If services based on one or the other of these methods are not highly efficient, they are likely to be superseded by lime contractors who are prepared to confine their attentions to bulk lime and perhaps bulk fertiliser operations (delivering and spreading). This type of service is already being given and has proved satisfactory and remunerative, particularly in areas where substantial tonnages of lime are used.

Farm or Railside Stockpiling

There are 15 stockpiles in operation in the North Island and several others are being established. The South Island has 3 in various stages of development. In both islands there is some stockpiling on farms. When farm stockpiles are built up outside periods of rail wagon shortages, they relieve rail transport as effectively as stockpiling at railway sidings. Lime from railside stockpiles is usually paid for by the twentieth of the month following that in which it is spread. This is not a practical arrangement with farm stockpiles, but some "easy" payment arrangements exist, most of them based on payment by a stipulated date, irrespective of whether spreading has been completed, or within 20 days of spreading, whichever is the earlier. In these circumstances, provided the farmer protects his stockpile from being trampled by stock and his spreading contractor gets the lime spread at the required time, farm stockpiling has much to commend it.

An obvious advantage of railside stockpiles is that all farmers in a district can draw on them as required. Some of them may place their orders in advance and others may depend on the foresight of the proprietor and try last-minute ordering. It is elasticity of this latter type which is one of the features of railside stockpiles; dilatory buyers are assisted and the railways are protected from the strain which such buyers would otherwise place on railway rolling stock.

◆

Symptoms of Foot and Mouth Disease

FOOT and mouth disease has become epidemic in Europe, Britain, and Canada. If it came to New Zealand, the disease might break out in the least expected place. The virus is very easily carried and is long lived.

Every precaution is being taken by inspection, fumigation, and destruction of suspect material at ports of entry to prevent introduction of the disease, but infection might infiltrate this barrier. It is therefore important that all people handling stock should be familiar with the symptoms of the disease and be on the alert to recognise them. These symptoms are given below, with advice on action necessary if presence of the disease is suspected. Delay would be folly if the disease were present. False alarms are preferable to reluctance to report suspect cases, which, if affected with foot and mouth disease and left uncontrolled, would threaten unparalleled disaster to the livestock industry. A copy of the list of symptoms should be kept for ready reference and a veterinary opinion obtained quickly if indications of stock unhealth suggest foot and mouth disease.

The symptoms of foot and mouth disease, which affects cattle, sheep, pigs, goats, deer, and other ruminants, are:—

1. A number of animals suddenly becoming lame. If more than one species, such as both cattle and sheep, are affected, the cases are particularly suspect.

2. A few hours before the lameness appears the animals will have been dull, feverish, and off their feed.

3. Excessive salivation is usual in cattle, with smacking of lips and movements of the tongue. It is rare in other species.

4. In cattle usually, in other species less commonly, whitish blisters appear on the tongue, the inner part of the upper lip, and pad.

In all species these blisters appear on the heels and in front of the cleft of the foot. In pigs the snout may have external blisters.

If a number of animals exhibit the above symptoms simultaneously, the nearest veterinary surgeon, livestock instructor (Department of Agriculture), or police station must be informed immediately.

No person, animal, vehicle, or material should be allowed to leave the farm until the veterinary surgeon has arrived.

Humans are relatively immune, but can be infected by drinking milk from affected animals.

All animals on a property where the disease is suspected should be immediately shedded or yarded, **provided this does not involve taking them across or near a public road**, which must be avoided. It is essential to isolate them under control to eliminate distribution of infective discharges.

METEOROLOGICAL RECORDS FOR MAY

Station	Height of station above M.S.L. (ft.)	Air temperatures in degrees (Fahrenheit)				Rainfall in inches					Bright sunshine hours
		Approx. mean	Difference from normal	Absolute maximum and minimum		Total fall	No. of days of rain	Difference from normal	Maximum fall		
				Maximum	Minimum				Amount	Date	
Kerikeri	201	54.2	— 2.1	70.6	35.6	3.59	17	— 3.60	0.79	20	131.1
Auckland	160	56.9	+ 0.3	68.2	41.9	4.03	16	— 0.76	0.62	18	103.1
Tauranga	10	53.0	— 0.6	68.8	33.1	3.11	14	— 2.02	1.11	18	158.4
Ruakura	131	50.8	— 0.6	65.4	28.2	3.91	16	— 0.59	0.64	18	111.0
Rotorua	969	49.2	— 1.0	65.4	31.2	3.23	13	— 2.05	0.75	18	136.2
Gisborne	12	52.4	— 1.0	74.8	30.2	0.90	10	— 3.87	0.20	28	187.8
New Plymouth ..	160	53.6	— 0.1	63.6	41.0	5.96	18	— 0.11	1.20	21	122.6
Napier	5	54.4	+ 1.6	73.4	32.3	0.47	4	— 2.87	0.25	22	190.9
Karioi	2125	45.8	+ 0.3	62.0	26.0	4.50	15	+ 0.48	0.70	1	
Wanganui	72	53.4	+ 0.4	66.0	34.5	2.45	12	— 0.67	0.48	1	121.8
Palmerston North .	110	51.6	+ 0.6	66.0	32.0	2.81	14	— 0.51	0.66	18	95.3
Waingawa	350	49.9	+ 0.4	69.2	27.0	2.72	14	— 1.33	0.73	25	142.9
Wellington	415	51.8	+ 0.5	68.9	38.7	6.57	13	+ 2.01	1.75	10	117.0
Nelson	5	49.9	+ 1.4	68.0	30.0	5.61	13	+ 2.57	1.15	26	160.0
Blenheim	12	50.6	+ 0.5	71.8	30.0	3.73	13	+ 1.20	0.91	26	175.8
Hokitika	12	48.6	— 0.1	59.9	32.1	14.89	21	+ 5.61	2.22	28	100.4
Hanmer	1225	46.2	+ 1.4	70.0	25.0	2.28	14	— 2.20	0.72	10	132.7
Christchurch ..	22	48.0	+ 0.4	76.2	24.4	2.81	13	— 0.04	0.88	25	148.6
Ashburton	323	48.1	+ 1.4	77.0	25.0	2.04	11	— 0.51	0.73	26	140.8
Timaru	56	46.4	— 0.4	76.0	24.4	1.03	9	— 0.50	0.44	16	140.0
Alexandra	520	43.8	+ 0.9	71.5	20.1	0.97	8	+ 0.06	0.34	17	133.0
Taieri	80	46.6	+ 0.7	72.2	24.2	0.73	15	— 1.36	0.16	1	116.9
Invercargill ..	32	46.4	+ 0.3	67.0	23.0	2.78	19	— 1.08	0.55	1	94.1

Inoculation of Lucerne Seed

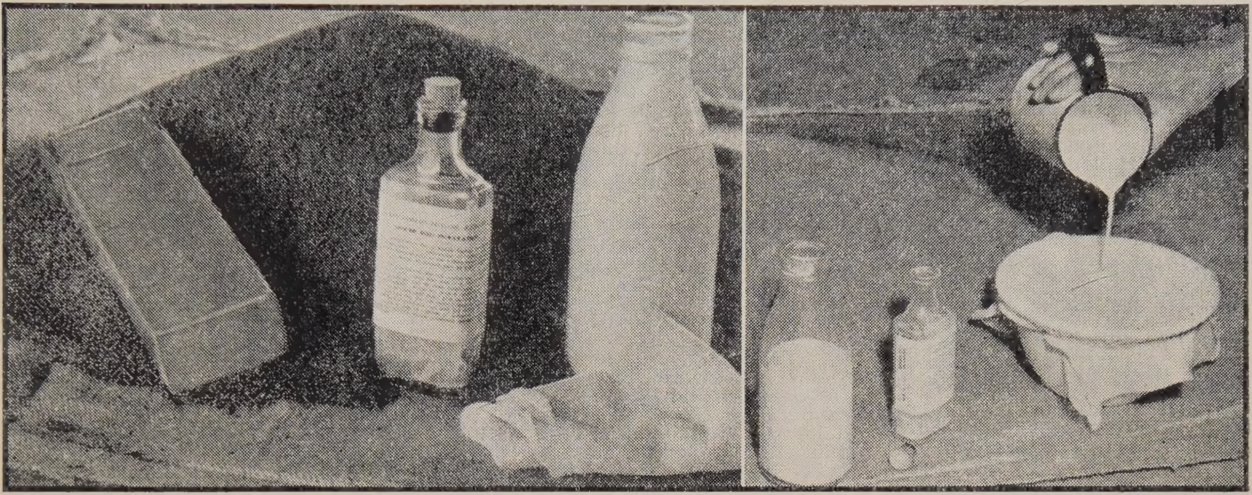
FOR the successful establishment of a lucerne stand there must be present in the soil a micro-organism with which the crop has been found to collaborate in a manner essential to its thrifty development. The organism may be present in some soils in numbers sufficient to meet requirements, but this cannot be determined before sowing. The safest course to adopt to ensure its presence is to supply the organism when the seed is sown, and this is done by what is called inoculation of the seed.

THE inoculum used for this purpose is prepared in Auckland by the Plant Diseases Division of the Department of Scientific and Industrial Research. It is usual for the merchant who supplies the seed to the grower to order at the same time sufficient inoculum to be delivered to the grower shortly before he intends to sow.

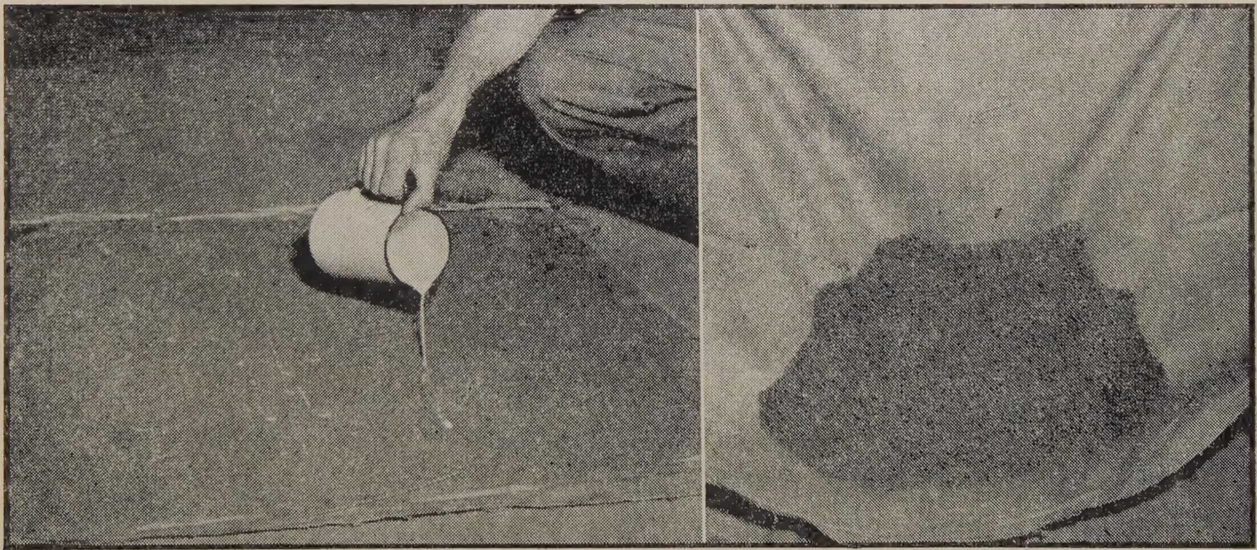
All the benefits of the inoculation of lucerne seed will be lost if the treated seed is brought into contact with soluble fertilisers such as superphosphate, sulphate of ammonia, nitrate of soda, or potash salts. Good results have been obtained by sowing the seed with a mixture of superphosphate and lime made up in equal proportions about a week before use.

The series of photographs and captions on this page illustrate the main points in inoculation.

—O. G. MOORE, Fields Instructor,
Department of Agriculture, Wellington



Left—The seed spread out, preferably on sacking, the bottle of inoculum sufficient for the quantity of seed to be treated, skimmed milk, and a piece of muslin. Right—After 2 or 3 tablespoons of skimmed milk have been poured into the bottle of inoculum to free the bacteria from the jelly the contents are mixed with sufficient milk (about ¼ pint to 30lb. of seed) to moisten the seed. The mixture of inoculum and skimmed milk is filtered through the muslin as shown to remove the jelly.



Left—The filtered milk culture is poured over the seed and thoroughly mixed with it to ensure that all seed is moistened. Right—The inoculated seed should be spread out, away from direct sunlight, and allowed to dry before sowing. It is advisable to turn the seed occasionally during drying.

Tuberculosis of Farm Animals

By P. J. McCANN, Veterinarian, Department of Agriculture, Hamilton

TUBERCULOSIS of man and animals is almost as old as civilisation. It was known to exist over 2000 years ago and lesions have been found in the bones of Egyptian mummies. There is evidence in Hindu literature (about 2000 B.C.) that tuberculosis was common in elephants at that time (1), and there are numerous references to the disease in Mosaic laws and Roman literature.

THE disease probably accompanied the spread of civilisation from Asia to the Mediterranean region and from there northward through Europe to the British Isles. There were laws against the consumption of tuberculous flesh in Germany as early as the 9th century (1). Although it is probable that bovine tuberculosis was introduced into Great Britain with cattle imported by the Romans, there is no evidence that the disease was common in farm animals until importations of dairy cattle from Holland began in the 17th century. Later, as a result of the industrial revolution, town dairies were established to supply milk to the growing populations of the manufacturing centres. Cows were housed continuously in over-crowded, unventilated stables in the towns, and in these herds tuberculosis soon became a disease of major importance. By comparison cattle kept on farms in the country remained relatively free. With the improvement of the dairy breeds in Britain and their subsequent export to other parts of the world bovine tuberculosis became widespread.

Disease Proved Infectious

Although the disease had been well known for centuries, there were many conflicting opinions regarding its nature. Many authorities considered it to be a kind of malignant tumour and others believed it to be infectious.

In 1865 the French army surgeon Villemin first proved that the disease was infectious. He inoculated sputum from man into rabbits and reproduced the disease in these. He repeated the same experiment, using tissue taken from tuberculous lesions of cattle. In 1882 Baumgarten first demonstrated the tubercle bacillus under the microscope and during the next 2 years Robert Koch placed the matter beyond all doubt by staining the bacillus in diseased tissue and by cultivating the organisms in pure culture on artificial media. He was able to reproduce the disease by inoculating these cultures into healthy laboratory animals and again recover the organisms from the diseased tissues of the experimental animals.

Economic Loss

The loss caused by tuberculosis to the livestock industry of New Zealand cannot be assessed accurately. The total dairy cow population is over 1,800,000, and if a conservative estimate (but see later) of 8 per cent. affected with tuberculosis is taken, it gives approximately 150,000 cows affected. The annual depreciation in the productive value of these cows would be difficult to estimate, but even if this were placed as low as £1 per cow, it would still represent the considerable annual loss of £150,000 to the dairy industry. It is probable that the actual loss is nearer double that figure.

During the year ended 31 March 1951, 9778 cattle (excluding calves), representing 1.67 per cent. of all cattle slaughtered in New Zealand, were totally condemned for tuberculosis on meat inspection. This means an estimated loss to the meat industry of nearly £80,000 in 1 year. If to this figure were added the value of offal and parts of carcasses condemned in cases of localised tuberculosis, it is probable that the figure would be more than doubled. In the same year 6939 pig carcasses (1.11 per cent. of total number of pigs killed) were totally condemned for tuberculosis, representing a loss in pig meat of about £30,000.

It is probable therefore that in loss of primary products alone bovine tuberculosis cost New Zealand well in excess of £300,000 annually.

Cause of Disease

Tuberculosis is a chronic infectious disease caused by a microscopic, rod-shaped bacillus known as *Mycobacterium tuberculosis.* The tubercle bacillus is not very resistant to heat and is destroyed by pasteurisation. Direct sunlight is rapidly fatal to it, but it is resistant to desiccation and so can survive for long periods in dust away from direct sunlight. It may remain alive for months in moist soil and it resists putrefaction fairly well. Most disinfectants will kill it, but it is somewhat resistant to acids and alkalis.

Thorough cooking, boiling, or roasting of meat will kill any tubercle bacilli that may be present, but the organisms are comparatively resistant to freezing and pickling.

Close herding of dairy stock, which cannot be avoided, facilitates spread of infection from "open" tuberculosis cases by coughing.

Types of Tubercle Bacilli

Though both Villemin and Koch believed that tuberculosis of man and animals was caused by the same organism, later workers showed there were three distinct types of tubercle bacilli mainly responsible for the disease in man, cattle, and birds. They were called the human, bovine, and avian types respectively. Their differences were based on cultural characteristics and in their varying ability to produce disease in different species.

The human type was found to be responsible for the great majority of cases in human beings. It plays a relatively unimportant role in animals, although domestic pets, such as dogs, cats, and parrots, may become infected from human sources. Cattle also have been known to be infected with the human-type bacillus, but in such cases the disease is always non-progressive and limited usually to a single lymph node.

The bovine type is responsible for practically all cases of tuberculosis in cattle and for most cases in other species of animals. Birds are highly resistant, although parrots are slightly susceptible.

Human beings are highly susceptible to infection with the bovine-type tubercle bacillus. As tuberculosis of bovine origin in man is almost invariably derived from infected milk, this type of the disease is much more common in children than adults.

It has been estimated in Great Britain that 5 per cent. of all deaths from tuberculosis were caused by the bovine-type bacillus, but in children under 5 years 30 per cent. of deaths were from tuberculosis of bovine origin.

Various surveys in Great Britain have placed the probable death rate in human beings from tuberculosis of bovine origin between 1000 and 2000 annually.

In New Zealand during 1950, 121 persons died from non-respiratory tuberculosis; many of these deaths were caused by the bovine-type bacillus.

The avian type is the only one found in birds, other than parrots, which are susceptible also to human- and bovine-type bacilli. The disease is commonest in domestic poultry, but avian infection is readily transmitted to pigs, and where infected poultry have access to piggeries it may result in condemnation or partial condemnation of pig carcasses due to the presence of visible tuberculous lesions.

Cattle are sometimes infected with the avian bacillus, but invariably the lesions are localised and non-progressive. Such cattle may be sensitised to tuberculin, but when they are moved from the environment of poultry they lose their tuberculin sensitivity within a few months. There has been one recorded case in New Zealand of avian-type infection in a human patient.

Incidence in Different Animals

Cattle: Tuberculosis is undoubtedly the most common and fatal infectious disease of cattle in New Zealand. Although accurate figures are not available, it can be reasonably estimated that 10 per cent. of dairy cows in New Zealand are infected. The figure will vary widely in different parts of the country, being highest in the most intensive dairying districts, such as the Waikato, where 20 per cent. probably would be a more accurate estimate.

[*National Publicity Studios photo.*

When tubercle bacilli are present in milk pigs and calves reared on skimmed milk become infected.

The class of cattle has a distinct bearing on the incidence of tuberculous infection, the disease being relatively uncommon in run cattle and in self-contained, home-bred herds in the more lightly stocked districts.

Again, the incidence is definitely lower in calves and yearlings than in cows; in fact in most cases cattle become infected only after they enter the milking herd.

The variations in incidence are due to the greater opportunities for infection among cows in dairy herds than among young cattle and cows kept in breeding districts and beef herds. As will be seen later, the main factor responsible for the spread of infection in cattle is the presence in the herd of so-called "open" cases, which are disseminating widespread infection.

Pigs: As tuberculous skimmed milk is the chief source of infection of pigs, the number of pigs affected is highest in districts where the incidence in cows is high. However, as most pigs are slaughtered at an early age, comparatively few ever show symptoms of the disease, which in most cases is confined to the lymph nodes of the neck or the mesenteric lymph nodes. About 15 per cent. of pigs slaughtered in New Zealand freezing works and abattoirs are found to be affected with tuberculosis, but owing to the early and localised nature of the lesions in most of these, relatively few carcasses are condemned (under 2 per cent.).

As pigs are also susceptible to infection with the avian bacillus, it is possible that a proportion of those found affected on meat inspection were infected from birds, but it would be impossible to differentiate these from cases of bovine-type infection without involved laboratory examinations. In the U.S.A. after the almost complete eradication of bovine tuberculosis the number of pig carcasses showing lesions remained high and this was found to be due to the high incidence of tuberculosis of poultry in that country. Under average farming conditions in New Zealand the possibility of pigs becoming infected from poultry is not great, but should always be borne in mind.

Sheep and goats: These animals are only rarely affected with tuberculosis. This is due entirely to the open-air type of husbandry usually employed and not to any natural resistance to the disease, as it is not uncommon in goats in countries where they are housed for intensive milk production, and it is not rare in sheep in Iceland, where they are housed during winter.

Dogs and cats: Tuberculosis in these animals is not uncommon. Cats are most frequently infected by drinking raw milk containing the bacilli, but occasionally both dogs and cats are infected from a human source.

Horses: The disease is comparatively rare in horses, but sometimes horses which as foals have been reared on cow's milk develop symptoms of the disease in later life. For this reason the non-pulmonary form of the disease is the most common in horses.

Poultry: Although tuberculosis in poultry is widespread in New Zealand, its incidence is low, particularly in commercial poultry flocks, as the poultry farmer culls severely after the first year. It is more common in domestic and farmyard flocks, which often are run on the same ground continuously. As the disease is confined to the digestive organs, infection is passed out in the droppings. Therefore poultry which are confined to the same area year after year are more likely to pick up infection. Full information on the disease in poultry is contained in the Department of Agriculture Bulletin No. 332, "Tuberculosis in Poultry".

Routes of Infection

Tubercle bacilli may enter the animal's body in different ways:—

Inhalation: Most cattle become infected by inhaling tubercle bacilli. An animal affected with tuberculosis of the lungs may cough frequently and discharge into the air droplets of sputum containing millions of bacilli. These are readily inhaled by animals close to the affected animal. Opportunities for this method of spread occur daily, for instance, at the shed during milking or in pens at saleyards where cows spend long periods close to other cows.

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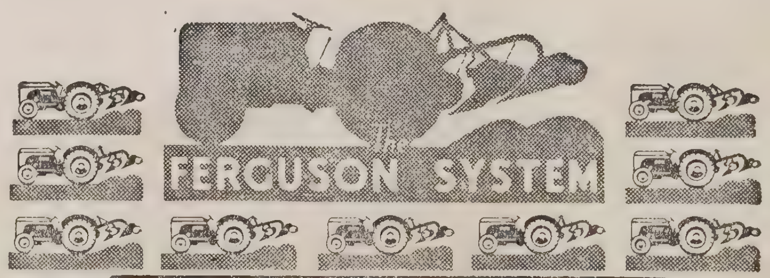

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Tubercle bacilli are resistant to drying and may be present in dust in the bails of milking sheds where they have been coughed up by infected cows. Thus inhalation of infected dust is another possible source of infection, though probably much less common than the previous one.

Ingestion: Tubercle bacilli may be taken in through the mouth with food (pasture, milk, or licks) or water. In a tuberculosis-infected herd a lick to which all stock have access is very undesirable. Under New Zealand's open-air system of dairy husbandry infection of cattle from food or water is probably more common than in other countries. For instance in Great Britain and America it is estimated that only about 15 per cent. of cattle are infested by swallowing the bacilli.

Under conditions favourable to the germs tubercle bacilli can survive for a long time on pasture, and as infected cattle may pass out large numbers of bacilli in their dung, the pastures may become heavily contaminated.

Where lick or feed boxes are used in the shed they may become infected with sputum and other cows feeding from the same box are almost certain to swallow infection. Communal water troughs are another possible source of infection.

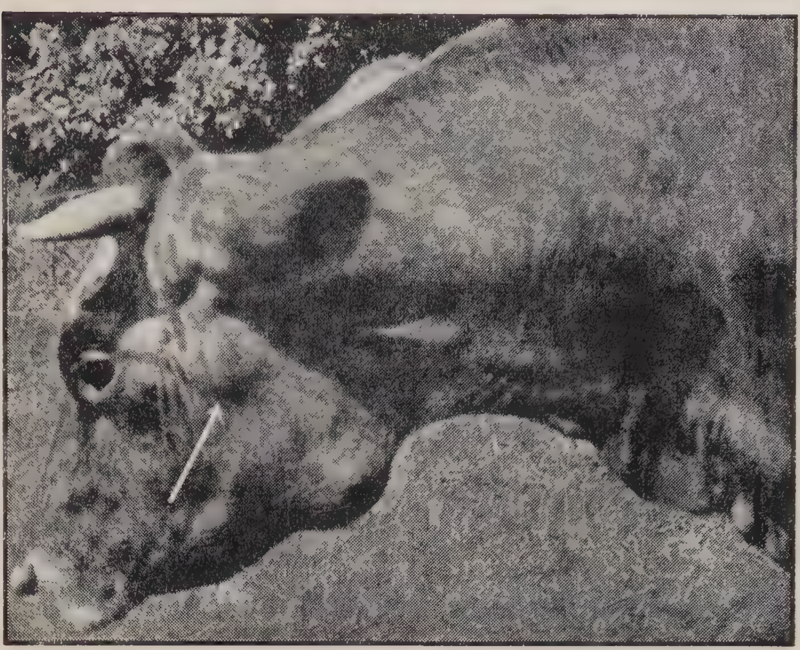
In spite of the numerous opportunities for cows to swallow tuberculous infection there is fairly conclusive evidence that infection by respiration is definitely more common in cows than infection by ingestion. This is probably explained by the fact that it has been found necessary to use a considerably greater dose of tubercle bacilli to infect calves experimentally when the germs were fed to the calves than was required when they were given as a fine spray.

The position with pigs is, however, quite different, as in most cases they are infected through swallowing tuberculous skimmed milk.

Wound infection: Tubercle bacilli may enter the body through wounds, scratches, or abrasions. This mode of infection is by no means rare and in cattle it is usually indicated by a tuberculous lesion in the lymph node draining the site of infection. Thus a tuberculous prescapular, precrural, or popliteal lymph node may be indicative of a wound infection in the corresponding limb, and tuberculosis of the inguinal lymph nodes in the pig is frequently the result of infection through castration wounds.

Congenital tuberculosis: The foetus may become infected while still in the uterus. This may occur when tuberculous lesions are present in the placenta of the mother and one of them erodes, allowing the escape of tubercle bacilli into the foetal blood vessels. Thus the calf may be born with tuberculosis and when the infection has been heavy the calf will die at an early age. Judged by the small number of bobby calves found to be affected, this mode of infection is comparatively rare.

Genital tuberculosis: When the sexual organs of the male or the female are tuberculous infection may be spread during coitus. This mode of infection is rare. Many farmers believe that a tuberculous bull may sometimes transmit infection to his progeny, but such is not the case.



Cow with enlarged parotid lymph node.

Tuberculosis cannot be inherited and it cannot exist in the ovum or sperm of the parents, even when these parents are tuberculous.

However, a bull which has tuberculous lesions on the penis (and this is rare) may infect the uterus of a cow. The disease thus established in the cow later may spread to the developing foetus which may either be aborted or may be born with congenital tuberculosis.

How Disease Develops in Body

Tubercle bacilli may enter the body without producing lesions at the point of entry. For instance, if they enter through the mucous membrane of the mouth or throat, there is usually no visible evidence of this in the mucous membrane and the first sign that infection has taken place is the development of lesions in the lymph nodes of the throat which drain the site of entry. The bacilli are arrested in the lymph node and begin to multiply. This stimulates a reaction on the part of the body, and its defensive mechanism comes into operation.

The body endeavours to localise the invading bacilli by surrounding them with dense fibrous tissue and in the centre of the lesion there are produced large numbers of cells which are capable of destroying bacteria. These cells are known as phagocytes. This proliferation of fibrous tissue and cells results in the formation of a nodule or tubercle (from the Latin word *Tuberculum*, a nodule).

Caseous Lesions

The tubercle increases in size and about 3 weeks after infection it may possibly be seen with difficulty by the highly trained naked eye or with a hand lens. It then appears as a grey, translucent nodule. Later, degeneration of the centre of the nodule takes place and it is then described as "caseous", owing to its characteristic cheesy appearance. Caseous lesions may be small and discreet, about the size of a pinhead, at which stage they are at least 30 days old.

If the defensive mechanism of the body is satisfactory and capable of dealing with the infection, the small caseous lesion is effectively encapsuled, and calcification by the deposition of lime salts in the caseous material occurs. Calcified lesions are hard and gritty to the touch and white. Although tubercle bacilli may be present in a calcified lesion, they are usually undergoing degeneration, and calcification is therefore regarded as a favourable development in the disease process, which may end in complete healing. In cattle, however, complete healing is rare.

Tuberculous Abscesses

If the defensive mechanism of the body is poor or the infecting dose of tubercle bacilli too massive for the phagocytes to deal with effectively, numerous tubercles are formed in the tissues where the bacilli become lodged. These develop to the stage of caseation and numerous small tubercles may coalesce to form much larger cheesy lesions. Instead of calcification taking place, liquefaction of the centre of the caseous lesions may occur, resulting in the formation of tuberculous abscesses, which contain a creamy, white pus.

Tuberculous abscesses are common in the lungs and they may break down, with the discharge of the creamy pus up through the air passages. The pus may be aspirated into other parts of the lungs and fresh tuberculous lesions thus established. The normal lung tissue eventually may be largely replaced by solid caseous areas and

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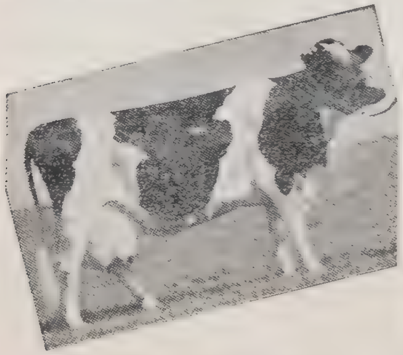

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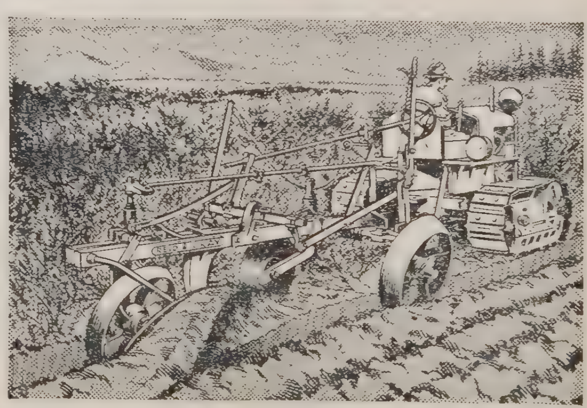

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tuberculous abscesses. The infective pus (or sputum, as it is called) may be coughed up and discharged into the air, either as semi-liquid sputum or as a fine spray containing millions of virulent bacilli. This sputum may be coughed up into the throat and swallowed; the bacilli are then passed out in the dung or they may cause ulceration of the intestines followed by lesions in the mesenteric lymph nodes draining the area.

The invading bacilli frequently are arrested first in the lymph node nearest to the point of entry. When an active lesion develops it results in considerable enlargement of the affected lymph node. The tubercle bacilli multiply in such a lesion and eventually escape into the lymphatic vessels and are carried to other nodes where similar lesions are produced. Eventually they may be carried by the lymphatic vessels to the systemic bloodstream and thence to other parts of the body. If bacilli invade the bloodstream in massive numbers, they become widely disseminated, first throughout the lung tissue and then throughout the other organs of the body. This form of the disease is called acute miliary tuberculosis, because the resulting lesions resemble millet seeds and are numerous, small, and evenly distributed through the organ. Acute miliary tuberculosis is a rapidly fatal stage of the disease.

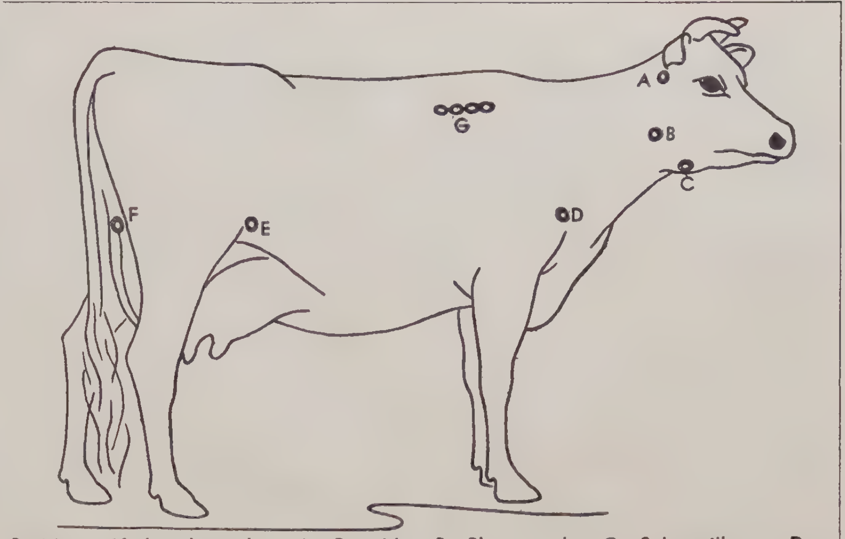
Symptoms in Cattle

Animals may be affected with tuberculosis for long periods without showing symptoms, many affected animals never show symptoms of the disease during life. The disease is chronic and usually develops slowly over a period of months or years, but sometimes, due to lowering of the animal's resistance, the disease may become active and acute, symptoms may suddenly appear in an advanced form, and death may rapidly supervene from acute miliary tuberculosis. Such a flare-up most frequently occurs in cows soon after calving, particularly when this has been complicated by some infection of the womb, or it may occur in cattle suffering from general debility due to malnutrition.

In most cases symptoms develop gradually and they vary widely according to the distribution of lesions inside the body. Except when it has reached an advanced stage, the disease is extremely difficult to diagnose with certainty by clinical examination and frequently an accurate diagnosis can be made only by the tuberculin test.

When symptoms are evident there is usually progressive loss of condition and eventually emaciation, the coat is dry and harsh and usually hidebound, the eyes become sunken and dull, and the appetite is variable.

As the respiratory system is most frequently affected, coughing is a common symptom. The cough is chronic and at first it may be hard and dry, but later it becomes soft, moist, and easy. If the animal is exercised forcibly and then allowed to rest, the cough will be even more pronounced. If the animal coughs while in the milking bail, a small, jellyish sputum may be found on the wall or door in front of the cow. As the destruction of lung tissue progresses breathing becomes more rapid and laboured, and in very advanced cases it is distressed.



Positions of lymph nodes: A—Parotid. B—Pharyngeal. C—Submaxillary. D—Prescapular. E—Precrural. F—Supramammary. The foregoing are all superficial. G—Mediastinal; these are inside the chest and when enlarged may press on the gullet, causing recurring bloat.

In many cases the superficial lymph nodes are affected and when these have become sufficiently large they can be detected by sight or by palpating them with the fingers. (Positions and names of these lymph nodes are given in the diagram above.) Lymph nodes in the region of the head are detected most readily in this way. Submaxillary nodes are situated just inside the angle of the jaw, one on each side. The pharyngeals are situated in the throat region behind the jaw and above the larynx. When they are enlarged they cause the "snoring" so common in dairy cows and this is due to pressure by the enlarged pharyngeal lymph node on the opening of the windpipe (larynx). The pharyngeal nodes can be seen only when grossly enlarged.

The parotid lymph nodes are situated one on each side of the head just below the ear and when enlarged they can be seen readily.

Other superficial lymph nodes which are often affected and consequently enlarged are the prescapular (just in front of the point of the shoulder), the precrural (in the loose tissue just above, and in front of, the stifle), and the supramammary lymph nodes (under the tail, above and behind the udder, and just below the escutcheon).

Tubercular lymph nodes usually increase in size slowly and there is no evidence of heat, pain, or inflammation. Frequently, particularly in young animals, the enlarged lymph node may develop into an abscess and rupture, discharging a creamy, white pus.

When the lymph nodes associated with the lungs are greatly enlarged they may cause pressure on the gullet and thus interfere with the cow's ability to belch. In such cases bloat, at first intermittent but later persistent, occurs. Thus if one cow in a herd has a tendency to bloat repeatedly when no other animal is similarly affected and feed conditions are not likely to be responsible, one should suspect tuberculosis as a possible cause, particularly if the animal is losing condition.

Tubercular ulcers of the intestines are rare, but if they occur, they may cause chronic diarrhoea.

Tuberculosis of the Udder

Although it would be impossible to say with accuracy what percentage of cows in New Zealand are affected with tuberculosis of the udder, recognisable lesions of tuberculosis have been found on post-mortem in the udder or its associated lymph nodes (supramammary) in approximately 1 per cent. of cows reacting to the tuberculin test. Frequently, however, the supramammary nodes are affected without the disease being present in the udder, so that not all of these cases would have been excreting tubercle bacilli in the milk. On the other hand, it has been shown that small numbers of tubercle bacilli may be excreted intermittently in the milk from apparently healthy udders. These bacilli may come from small, undetectable lesions in the udder, and it is possible that bacilli which enter the bloodstream from a lesion in some other part of the body may pass out in the milk.

Tuberculosis of the udder cannot be diagnosed clinically until it is well advanced.

Any gradual increase in size of a quarter without inflammation and without any alteration in the colour or character of the milk secretion should be regarded with suspicion. The enlargement is accompanied by a progressive hardening (induration) of the quarter. This induration may be nodular or diffuse and is difficult or even impossible to distinguish from many cases of chronic mastitis. However, in the latter there is usually some change in the character of the milk, such as the presence of clots in the fore-milk. When tuberculosis of the udder reaches an advanced stage the affected quarter may be greatly enlarged, the udder very uneven, and the milk first brownish and later thin, watery, and straw coloured with yellowish flakes in it.

When the udder is affected with tuberculosis, tubercle bacilli can be detected by microscopical examination of the milk. However, failure to find tubercle bacilli is not conclusive evidence that they are not present in the sample and this evidence can be obtained only by biological examination, which involves the inoculation of guinea pigs. This necessitates a delay of 3 to 6 weeks. For this reason examination of milk samples for tuberculosis is of no practical value in safeguarding the milk supply, the tuberculin test being infinitely more satisfactory.

Tuberculosis of Genital Organs

The uterus may become infected by spread of bacilli via the bloodstream from some other part of the body, occasionally by direct spread from the abdominal cavity, and very rarely it may become infected after service by a bull with tuberculosis infection of the penis or testicles. There are no symptoms typical of tuberculosis of the uterus, but cows may abort late in pregnancy, and if lesions involve the placenta, the calf may be born with congenital tuberculosis. Evidence of this is found on post-mortem examination of the calf, when numerous, small, nodular lesions of tuberculosis are seen to be distributed evenly throughout the liver. This is conclusive evidence that the dam of the calf is affected with tuberculosis of the uterus.

There is nothing characteristic about an abortion due to tuberculous infection of the uterus and it would require a laboratory examination of the placenta to distinguish it from contagious abortion (*Brucella abortus*). In countries where tuberculosis of poultry is common infection of cows with avian-type bacilli is a frequent cause of abortion without producing any other disturbance of the cow's health.

Tuberculosis of the genital organs of the bull is very rare and when it does occur it is usually part of a generalised tuberculosis of the animal.

Tubercular lesions may occur occasionally in the brain or spinal cord. The disease cannot be diagnosed definitely by clinical examination, as similar symptoms could be caused by any other infection of the central nervous system. In these cases symptoms usually take the form of excitability, abnormal gait, or partial paralysis and these are accompanied by progressive emaciation.

Tuberculosis of the skin occurs rarely as a result of wound infection and takes the form of a hard, greyish nodule with a cheesy or necrotic centre. More frequently tubercular enlargement of the prescapular or other carcass lymph nodes may occur as a result of infection through skin wounds without recognisable lesions at the point of entry of the bacilli.

So-called "skin tuberculosis" of cattle is seen occasionally in New Zealand. The lesions are hard, painless nodules varying in size from that of a pea to that of a walnut and are usually in a chain formation on the limbs. Frequently there are acid-fast bacilli in the nodules, but they cannot be grown in culture and cannot be transmitted to other animals. They have no detrimental effect on the health of the beast.

Symptoms in Other Animals

In other domesticated animals the symptoms of tuberculosis are as follows:—

Pigs: As most pigs are killed at an early age, symptoms are rarely seen. However, older pigs, particularly sows after farrowing, may start to lose condition, gradually become emaciated, and die in 2 or 3 months. Sometimes they may be affected with chronic diarrhoea and occasionally they have enlarged joints. A tuberculin test is necessary before a definite diagnosis can be given.

Horses: The disease runs a very chronic course with gradual emaciation as the only definite symptom. Occasionally the disease is in the vertebrae of the neck, causing a characteristic stiff or wry neck.

Dogs and cats: Muscular wasting is very pronounced, particularly in the region of the temples. Coughing sometimes occurs, breathing may be rapid and laboured, and occasionally the abdomen is enlarged.

Cows in the last stages of tuberculosis become weak and emaciated.

Tuberculosis in horses, dogs, cats, sheep, and goats is rare and cannot be diagnosed with certainty by clinical examination alone.

Tuberculin Test

The only accurate method of detecting animals affected with tuberculosis is by the tuberculin test.

Tuberculin is produced by growing tubercle bacilli artificially in a culture medium of glycerine broth. After several weeks' growth the cultures are boiled to destroy the tubercle bacilli, which are then removed by passing the sterilised culture medium through porcelain filters. These are fine enough to hold back the dead tubercle bacilli. The filtrate contains a protein substance, known as tuberculo-protein, produced by the bacilli during their growth in the medium. The filtrate is evaporated to a standard concentration and is then tuberculin.

Tuberculin was first discovered by Koch in 1890; he showed that when it was injected into tuberculous animals it produced a general reaction characterised by fever and malaise; healthy animals were unaffected by it. This was later shown to be an allergic reaction, tuberculous animals being sensitive to the tuberculo-protein contained in tuberculin.

Subcutaneous Test

For many years the subcutaneous test was the standard tuberculin test. A measured dose of Koch's old tuberculin was injected under the skin. Temperatures were read immediately before the test and at intervals after the injection. A positive reaction was indicated by a rise in temperature.

Ophthalmic Test

The ophthalmic test was sometimes used in combination with the subcutaneous test. A drop of concentrated tuberculin was instilled into the eye, and several hours later in positive cases there was conjunctivitis and swelling of the eyelids and a thick discharge appeared in the eye corner. The test, however, was never widely used, as it was found to be less reliable than the other tests.

Intradermal Test

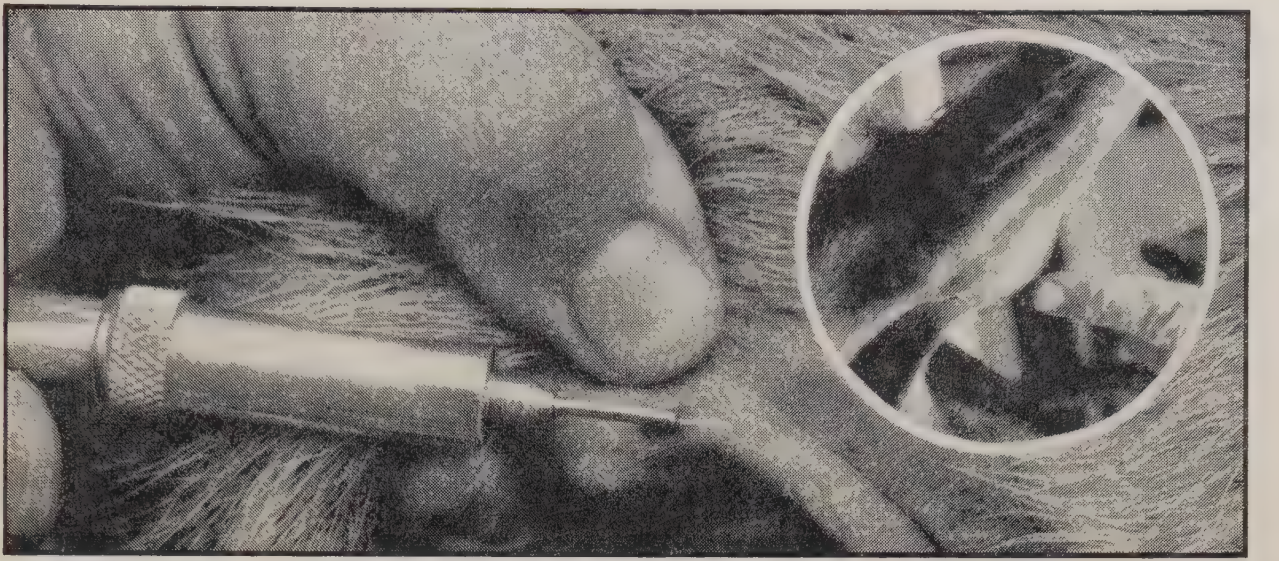
The intradermal test is the one now in general use in New Zealand. A minute dose of concentrated tuberculin is injected into the thickness of the skin of the right or left caudal fold, the other fold remaining as a control. The two caudal folds are situated just under the root of the tail.

Tuberculin is not injected under the skin, but is placed in the skin.

The test is read 3 to 4 days after the injection. Any swelling of the skin at the site of injection constitutes a positive reaction.

The chief advantages of the intradermal test over the subcutaneous test are that it can be applied more quickly, it involves much less handling of the stock, and the temperature test was found to be unreliable with excitable cattle unaccustomed to being handled. The intradermal test is also used for pigs and poultry, the injection being made into the skin of the ears of pigs and into the wattles of poultry.

Though tuberculo-protein is responsible for the reaction in tuberculous animals, some difficulty used to be experienced with so-called "broth-allergic" reactors, that is, healthy animals



The tuberculin test. Injecting tuberculin into the skin of one of the caudal folds, which are just under the root of the tail. Inset—A positive reaction to the test: A swelling of the skin at the site of injection.

which were sensitive to the protein derived from the broth culture medium used in the production of tuberculin. Such animals gave a doubtful reaction to the test, which made interpretation difficult. However, this difficulty was overcome by the production of synthetic medium tuberculin; the bacilli were grown on a protein-free medium, the nitrogen being provided by asparagin, and consequently the tuberculo-protein was unmixed with other proteins.

Reliability of Test

Though the tuberculin test is not perfect, it cannot be denied that it is an extremely valuable diagnostic agent, especially since the introduction of synthetic medium tuberculin. A small percentage of cattle affected with tuberculosis will fail to react to the test. These usually fall into one of three categories:—

Animals which have been infected very recently: Experimental and field evidence indicates that usually 20 to 30 days elapse after infection before an animal reacts to the tuberculin test.

Some cattle in the advanced stages of the disease which tend to lose their skin sensitivity to tuberculin: Such animals as a rule can be readily detected as clinical cases of tuberculosis.

A few tuberculous cows which lose their skin sensitivity to tuberculin for a short period after calving: These were observed by workers in Northern Ireland, who also showed that some calves fed on colostrum from infected cows became for the time being allergic to tuberculin. They considered the probable explanation of this phenomenon was that colostrum, being rich in antibodies, induced a withdrawal of antibodies specific for tuberculo-protein from their normal place in the skin, thus lowering for a brief period the allergic state of the skin, and the tuberculin sensitivity was temporarily transferred to the calf drinking the colostrum.

In New Zealand the number of infected cattle which fail to react to the test is considered to be an extremely small proportion of the total number of cattle tested. Although no precise figures can be quoted to support this statement, confirmation is accumulating slowly from reports from meat inspectors of post-mortem examinations of cattle with official eartags killed at freezing works and abattoirs. Records of tag numbers and post-mortem reports are kept and these can be traced to the herd of origin by reference to the testing records. Early indications are that few, if any, of these cows have on post-mortem examination shown lesions of tuberculosis.

No-visible-lesion reactors: A small margin of error in the test is also possible in the opposite direction—post-mortem examination of a few reactors does not disclose visible lesions of tuberculosis. The proportion of these cases varies from 2 to 10 per cent. of the total reactors. There are three possible explanations of these reactions:—

1. They are recently infected cattle which have reached the stage of tuberculin sensitivity, but lesions are not yet sufficiently large or numerous to be found in ordinary meat inspection. This does not indicate a weakness in the system of meat inspection, as such small lesions will not be present in edible parts of the carcass without there being older and more readily discernible lesions in the lymph nodes of the head, lungs, or other organs.
2. A small, non-progressive, possibly calcified lesion might be present in the substance of an organ, such as the lung, but might not be detected during the post-mortem examination. Such a lesion would sensitise the animal to tuberculin.
3. In rare instances a few animals may be infected with acid-fast organisms other than bovine tubercle bacilli, for example, avian or human types of tubercle bacilli, the acid-fast bacilli present in the so-called "skin tuberculosis" and infection with Johne's disease (*M. johnei*). Infection with these organisms will produce a varying degree of sensitivity to the tuberculin test in animals free of bovine infection.

However, these non-specific reactions appear to occur less frequently in New Zealand than, for instance, in Great Britain and U.S.A. Avian tuberculosis is not so common here and does not appear to be a serious complicating factor in the widespread use of the tuberculin test. In New Zealand it is probable that most no-visible-lesion reactors fall into the first two categories.

Control and Eradication

Control and eradication of tuberculosis must be considered under two headings: Herd control or eradication; area eradication.

Herd Control or Eradication

Reporting and slaughter of obvious clinical cases of tuberculosis as required by the Stock Act 1908 have done little to reduce the incidence of tuberculosis in cattle. By the time affected cows have reached the stage of showing obvious clinical symptoms they have usually been spreading tubercle bacilli for some time and many cattle transmitting tuberculosis appear to be perfectly healthy cattle.

Some method of control must be adopted if progress is to be made in reducing the incidence of tuberculosis. This applies equally to tuberculosis in herds throughout New Zealand and individual herds.

In the latter the disease usually can be eradicated quickly by using the tuberculin test. All reactors to the test must be slaughtered without delay, but this creates a serious difficulty for owners of badly infected herds. Few dairy farmers can afford to have 50 per cent. or more of the herd condemned at one test, even when this is done toward the end of the milking season. Even when the herd history has been good, with comparatively few losses from clinical tuberculosis, an unexpectedly high percentage of reactors may be found.

A cautious policy is therefore usually adopted when an owner asks for his herd to be tuberculin tested, and only a portion of the herd is tested at first to obtain an estimate of the degree of infection of the herd. From the result of this test the owner is in a position to judge whether he can afford to proceed with the testing of the whole herd. Where the infection proves to be heavy only a portion of the dairy herd is tested each year, but all the young stock are tested and the owner is encouraged to rear as many heifer calves as possible to provide more replacements and so permit heavier culling of older cows.

Tuberculosis has been successfully eradicated by this method from many badly infected herds, but it takes a number of years. The proportion of the dairy cows tested should be as high as is economically possible and testing should be done annually about the end of the milking season. A close watch must always be kept for any suspicious symptoms in cows that have not been tested, and if they are considered by a veterinarian to be clinical cases of tuberculosis, they must be slaughtered immediately.

Usually the incidence of tuberculosis is much lower in calves and yearlings than in milking cows and normally even in badly infected herds the percentage of reactors among young cattle is low. There are exceptions and these are likely to be on farms where the calves have been fed on tuberculous skimmed milk or where the young stock are grazed regularly with cows.

As herds will contain a number of infected though apparently healthy cows every effort must be made to maintain their bodily resistance at the highest level to avoid the risk of a clinical breakdown in these animals. Thus good nutrition at all times is essential. Ample reserves of good supplementary feed must be maintained and over-stocking avoided. Care should be taken that the cows are not subjected to undue physical stress by feed shortages in severe weather or in the latter part of pregnancy and during heavy lactation.

When eventually the herd has been cleaned up it should be retested every year. As far as possible the herd should be self-contained, but if replacements have to be bought, it is advisable to have them tested before they are brought on to the farm. If that cannot be arranged, it is recommended that newly acquired cattle should be kept in a separate paddock and tested as soon as possible after their arrival on the farm.

Where trouble has been taken to eliminate tuberculosis from a herd a continued effort to keep the herd free of the disease is worth while.

Tuberculin testing is done free by Government veterinarians and all inquiries on the subject should be addressed to the nearest office of the Department of Agriculture.

Under Section 84 of the Statutes Amendment Act 1945 it became compulsory for all cattle in town-supply herds to be tuberculin tested each year. This work is well under way and after some preliminary difficulties steady progress is being made.

Area Eradication

Tuberculosis could be eradicated from New Zealand. Unlike many other serious diseases of stock, it can be diagnosed readily with accuracy by the tuberculin test. Because tuberculosis causes serious economic loss through unthriftiness and deaths of cattle and pigs are through condemnation of meat, and because it is responsible for prolonged illness and death of many human patients, mostly young people, eradication of the disease from cattle in New Zealand is an objective worthy of the greatest and most persistent efforts.

Other countries reached this conclusion years ago and almost every country in the world with a large and highly developed dairy industry has a bovine tuberculosis eradication scheme. The classical example of large-scale disease eradication is the campaign of the U.S.A. Bureau of Animal Industry against bovine tuberculosis. The plan involved the tuberculin testing of all cattle in the U.S.A. and the slaughter of all reactors. The work was done gradually, testing being begun in one area and then extended to others.

In 1922 it was estimated that about 4 per cent. of all cattle in the United States were infected with tuberculosis. In some areas, particularly in the eastern States, the incidence was so high that over 30 per cent. were reactors. By 1944 bovine tuberculosis had been virtually eradicated, the percentage of reactors being 0.18 of approximately 10,000,000 cattle tested that year (1).

The effect on the meat industry in the United States can be appreciated when it is realised that in 1917, 40,746 carcasses of beef were totally condemned for tuberculosis, whereas in 1946 this figure had been reduced to 1058, a saving of over 40,000 beef carcasses annually (2). In addition there is the considerable and possibly greater saving which must have resulted from reduced condemnations of part carcasses and edible offal.

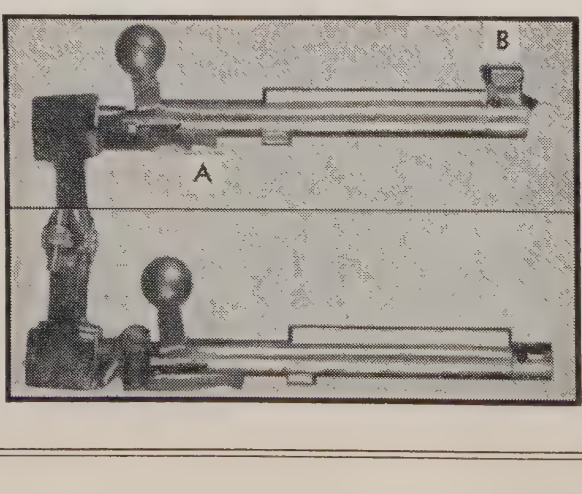
At the same time there has been a marked fall in the incidence of non-pulmonary tuberculosis in human beings—from a death-rate of 22.5 per 100,000 in 1917 to 3.5 in 1946, and it is reported now to be even rarer (2). This fall has no doubt been brought about partly by more widespread pasteurisation of milk.

Other countries have also carried out successful tuberculosis-eradication schemes, although on a smaller scale. The first was Finland, which began as early as 1899. An incidence of 10 per cent. was reduced by 1935 to 0.85 per cent. Progress in the early years must have been very slow, as the recognised test at that time was the cumbersome subcutaneous test. Considerable progress toward total eradication has also been made by Denmark, Norway, Portugal, Canada, and in many other countries, including Great Britain, eradication schemes based on the tuberculin tests and area eradication are well established. In Great Britain at September 1951 there were nearly 3,000,000 cattle in attested herds under the tuberculosis (attested herds) scheme, the figure being 29.4 per cent. of total cattle.

References

1. "Bovine Tuberculosis", J. Francis (1947).
2. "Textbook of Meat Inspection", H. Thornton (1949).

"The Infectious Diseases of Domestic Animals", W. A. Hagan (1947).



Two Causes of Firearm Accidents

FILING the half-cock notch on the bolt of a rifle to form a hair trigger is a dangerous practice and one that can easily lead to fatal accidents. Illustrated at left are two bolts from .303 rifles. On the upper bolt the half-cock notch (A), which prevents the striker from reaching the cartridge if the sear becomes unseated by some cause other than pressure on the trigger, is intact. The half-cock notch on the lower bolt has been filed out. If the rifle incorporating the lower bolt received a blow on the cocking piece or was jarred, it could accidentally fire.

If the bore of a firearm is blocked, the user should never attempt to clear it by firing the weapon. The bolt-head, shown as B on the upper bolt, was blown off the lower bolt because of a blockage in the bore and the person using the rifle was killed by flying fragments. Users of firearms should always examine the bore to see that it is clear before the weapon is loaded.

—*G. G. KELLY*

Rearing and Feeding Chickens in Household Flocks

At this season the attention of poultry keepers is focused upon the breeding and raising of chickens. For the majority of owners of household flocks these two aspects are of little interest, but inquiries received by the Department of Agriculture, indicate that some want additional information upon these subjects, which are given in this article by the Animal Industry Division.

It cannot be recommended that household poultry keepers should undertake the breeding of poultry. This operation should be left to the commercial poultry farmer, who has the specialised knowledge and the facilities for raising replacement stock. Breeding stock should consist of carefully selected birds of above-average quality and in the main should be breeding hens, not pullets. The household poultry keeper has too few birds to permit a proper selection for breeding and in most cases runs a preponderance of pullets.

It is strange that there are a few who still believe that the presence of a male bird among laying birds stimulates egg production. There is no evidence to support this theory. Indeed the inclusion of a male bird in the pen will do more harm, because with eggs saved and preserved during the spring and summer flush for use in winter a fertile egg is more likely to deteriorate or break down completely when preserved than an infertile egg. Consequently householders are strongly recommended not to keep a male bird with their laying birds, and in the few cases where breeding is undertaken male birds should be removed immediately after the breeding season to ensure that only infertile eggs are available for preserving or other purposes.

Chick Raising

Most household poultry keepers replace at least some laying birds annually, and a decision has to be made regarding the age of pullet replacements to be purchased. The older the pullets and the nearer they are to laying the higher the price. Some householders purchase perching pullets 6 to 8 weeks old, because such birds are cheaper than pullets on point of lay. Day-old pullets are still cheaper, but they have to be raised to the laying stage, during which period losses occur and food costs will be considerable.

Chick rearing from day-old to laying stage is a skilled and detailed operation, particularly during the first 6 weeks. Mistakes in management during rearing may well lead to serious losses or to unthrifty, poor birds among those which survive. Any check during rearing due to faulty management is likely to be reflected in the constitution of the pullet and its ability to produce satisfactorily as a laying bird.

For the above reasons household poultry keepers are not recommended to attempt raising replacement pullets from day-old chicks. Here again the specialised work of chick rearing is best left to commercial producers, who have both the knowledge and the equipment to carry out satisfactory rearing.

However, apparently some household poultry keepers wish to raise pullets from day-old chicks or to rear cockerels for table purposes. For this reason some of the essentials of chick rearing will be discussed.

First, chicks may be raised under a hen or artificially with some type of brooder, which will supply the warmth necessary for young chicks during the first few weeks of life. Where a good broody hen is available natural rearing will offer fewer problems. A description of natural rearing is given in the Department of Agriculture

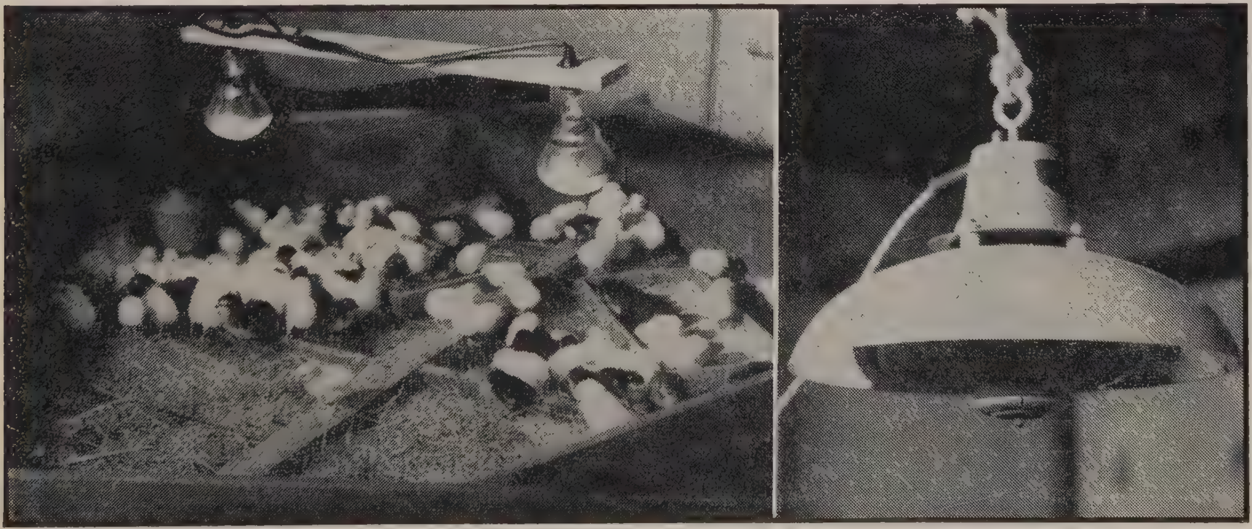
Reminders for August

This month, when the egg flush season starts, all laying birds should be producing heavily. Any bird not in lay at this time is unprofitable and should be culled.

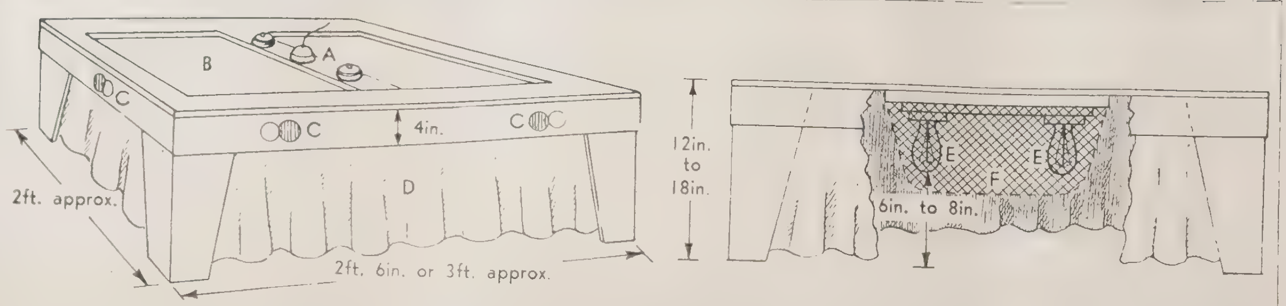
A bird in lay has a bright face and comb. The vent should be enlarged and moist, not small and dry or in a condition obviously indicating that eggs are not being passed through it.

Birds in full lay have an increased appetite; do not underfeed them at this time of year.

Any birds showing broodiness (particularly heavy-breed birds) should be removed from nests and placed in a broody coop. Birds in a broody coop should be fed the same food, in similar quantities, to the other birds if they are to be kept in lay. They should be 3 or 4 days in the broody coop and then be returned to the pen.



Left—Chicks brooded with infra-red bright emitter lamps. A wooden surround limits the area available to the chicks, which are only a few days old. The surrounds are gradually opened up as the chicks grow and become accustomed to the source of warmth. Right—Infra-red dull emitter unit, which can be used in the same way as the lamps at left.



Useful brooder heated with electric lamps and suitable for small units of chicks. The lamps should be painted with fire-proof red paint to reduce the amount of light. A—Plug and switches. B—Fibreboard top. C—Ventilators. D—Side curtains of brown paper, felt, or old blanket. E—40-watt lamps. F—Wire-netting guard.

Bulletin No. 199, "Chick Raising", which is available from offices of the Department at 6d. post free.

Artificial Rearing

With artificial rearing there are two prerequisites to success: A suitable house in which to brood the chicks and brooding equipment to supply warmth and protection during the first month. Household poultry keepers are urged not to use improvised methods of warming chickens, such as the use of hot-water bottles or a warm airing cupboard. Such methods usually end in failure or at best birds which are below a reasonable standard.

Chicks should be reared in a brooder house, shed, or room which is well lighted, has plenty of ventilation without draughts, and has a dry floor. Chicks should be protected from cold draughts and dampness, but do not require coddling. The range of brooding equipment available today is greater than it used to be. The electric brooders commonly used by commercial producers are not suitable for small units of chicks of from 25 to 50 birds. Bulletin No. 199 gives a design of small electric brooder heated by ordinary electric lamps. This piece of equipment is simple and easily constructed.

Recent additions to brooder equipment are infra-red brooding bright emitter lamps or dull emitter units. The method of brooding depends upon the infra-red heat radiated on to the chicks from either a lamp or infra-red unit suspended above the chicks, and is a system well suited for small units of chicks. Where infra-red brooding equipment, which is available throughout New Zealand, is used the maker's instructions regarding setting up and operation should be followed carefully.

Whatever type of brooder is used the following basic management should be observed:—

1. The floor of the chick pen should be covered with at least 2in. of dry litter such as chopped straw or dry sand and chopped straw.

2. During the first 2 or 3 days the young chicks should be confined within a fairly small space immediately around the brooder or under the infra-red heater to teach them where the source of heat is and to prevent them from wandering away and becoming chilled.

3. Once chicks are accustomed to the source of warmth the surrounds confining the chicks may be opened up gradually and the area enlarged until ultimately the chicks have the run of the complete pen. Metal, wood, or stiff cardboard may be used for the surrounds, which should be about 2ft. high.

4. Chopped straw under the brooder should be stirred up, added to and replaced, or replaced daily according to condition of the litter where the chicks gather for warmth and rest. It is essential to have the litter clean and dry in this area and of sufficient depth that the chicks do not come in contact with the floor.

5. Keep the remainder of litter dry and reasonably clean. Avoid having wet litter round the drinkers, as wet patches of litter are a source of danger and may cause an outbreak of disease.

6. Never allow the chicks to huddle and bank in the corners of the pen at night. If this happens, some chicks may be suffocated or crushed, and the remainder will "sweat" or overheat, which is detrimental to their health.

A more detailed account of brooding chickens is given in Bulletin No. 199.

Feeding Chickens

The simplest method of feeding chickens is to give dry mash and grain. The mash, which should be standard chick mash No. 1, is fed on wooden trays during the first week and then in troughs. This meal may be given during the first 6 to 8 weeks.

As many chicks are reared indoors or during the months when there is not a great deal of sunlight, it is essential to feed a fish oil in the mash to provide the chicks with the vitamin D which they would get from adequate exposure to sunshine.

Vitamin D assists in the formation of bone and prevention of rickets. A number of small-unit poultry keepers fail to feed fish oil to their chickens, with the result that chickens develop lameness and are generally unthrifty. This oil also supplies vitamin A, which is also important in the maintenance of health and even growth. Fish oil suitable for poultry is obtainable from vendors of poultry foods such as grain merchants and egg floors. Approximately 3 tablespoons of oil to every 10lb. of chick mash is required, or ¾ pint to 100lb. of mash. The oil should be mixed in thoroughly to give even distribution.

Mash and Grain

Dry mash may be fed from the day-old stage onward; it should be kept before the chicks at all times. Three grain feeds should be given daily (morning, noon, and late afternoon) with the mash using chick feed No. 1 for the first 3 weeks and chick feed No. 2 for the next 3 weeks. In the earlier stages this is best fed on a wooden tray, where it is easily seen. Later it may be fed in the litter, when the chicks will scratch for it. In addition chicks require fresh water daily and access at all times to a fine hard grit. The size of this grit is increased as the birds grow. Of importance also is a daily feed of finely chopped green food (silver beet, lettuce, lawn clippings, etc.). Green food should be young, fresh, and succulent; old, fibrous, and "dry" greenfood can be detrimental to chickens and has little or no feeding value.

There are no short cuts if the best type of chicken is to be raised. Hygienic conditions, regular and correct feeding, and constant observation to see that all is well are basic points of good management.

Investigation of Harrier Hawks

An investigation of harrier hawks by marking the birds with metal bands on their legs is being carried out by the Animal Ecology Section of the Department of Scientific and Industrial Research in conjunction with the New Zealand Ornithological Society. The harrier hawk is of considerable interest as a predator of both game birds and rabbits, yet very little is known about its behaviour and habits. Marking these birds should not only provide much information about their movements, but also give some indication of how effective is the bounty system that is worked in some districts to control their numbers.

Already some results have been achieved from this study, and a hawk which was marked in Hawkes Bay in April this year was found near Lake Waitaki, North Otago, over 500 miles away, a month later.

Anyone finding a marked bird is asked to co-operate in these investigations by sending the leg band to the Dominion Museum, Wellington.

Using Firearms Safely and Skilfully

LAST month's article in this series by G. G. Kelly, Arms and Ballistics Officer to the Police Department, described types of shotguns and the differences between hammerless and exposed-hammer guns. This, the concluding article of the series, deals with the construction of shotgun barrels, grades of shot pellets, and the taking of patterns of shotguns.

A SHOTGUN barrel is bored to suit the class of work for which the weapon is to be used. The usual trade practice is to bore the right barrel to shoot a rather open pattern and the left to shoot a close one; these are called improved cylinder and choke borings respectively. There are other combinations of borings for special purposes. For instance, the clay-bird competitor requires a gun to place the bulk, say 70 per cent., of the shot pellets in a 30in. circle at 40yds., but such a gun is specially adapted for this work and requires a high degree of skill to use successfully in breaking, as the competitor must, every "bird" to win an important match; this and other types of specially bored weapons are outside the sphere of this series of articles.

Best results are obtained with the shotgun when the barrels are correct for the purpose intended, and on this principle depends the degree of success. One well-known expert has expressed it thus: "The shot in their momentum do the killing; the pattern does the hitting". The momentum of the fired pellets is the same at the muzzle for all the standard borings and for all gauges, but the larger pellets have greater striking energy. However, for a successful shot there must be sufficient pellets to form a pattern and to "do the hitting".

Wider Pattern for Closer Shots

For closer shots a wider pattern is useful, as it gives the shooter a better chance of hitting. At longer ranges the left or "choked" barrel, with its greater concentration of pellets, gives a good second chance of sufficient pellets hitting the game. This is so important that men of experience will never use a gun which has not a fairly well-choked left barrel.

The forward trigger controls the right barrel and is usually drawn first; that is why the right barrel is bored to allow a quicker spread of the pellets, the game being usually closer to the gun for that first shot.

Choke is a constriction in the muzzle end of the barrel. It is measured in thousandths of an inch called points. Therefore a true cylinder barrel has no muzzle constriction, an improved cylinder has 5 points, a half choke 20 points, and a full choke 40 points.

The shot pellets are graded into sizes. The rule is to use small sizes for small game and the largest sizes for the biggest, but this is a matter of choice in real practice. Gun dealers and factories report that size 4 shot (191 to the 1⅛oz. charge) is the most popular size. The table below shows the usual sizes loaded in the Dominion. Some shooters use size 5 for the first, or right barrel, and size 4 for the left. Others use either size 5 or size 4 for both barrels. Orchardists may choose size 8 (478 pellets to the standard load), as the smaller pellets are less damaging to trees, though big enough to kill bird pests.

For the learner, who is advised to start his shooting practice with rabbits, size 4 or 5 will prove satisfactory. As he gains experience he will be able to decide his own requirements.

Taking Shotgun Patterns

The taking of shotgun patterns is a simple operation. A target face of rough boards about 5ft. square is erected 40yds. from the shooter so that its centre is level with his eyes. A sheet of plain paper about 4ft. square and on which is drawn with crayon, charcoal, or boot polish an aiming mark about the "close-up" size of a quail in flight is pinned to the target face, and the tester fires at the mark. One sheet of paper will serve for three shots from one barrel. After each of the three shots has been fired the result is recorded by counting the number of pellet holes within a circle of 15in. radius scribed from the centre of the main group of holes. The circle can be drawn with a lath of wood with two nails driven through it 15in. apart; one nail acts as the anchor and the other as the scriber. In the counting of the shot holes each hole is marked with a pencil so that none is missed or counted twice. The three totals for the three shots fired are added and divided by three to obtain the average. This average is converted to a percentage of the total number of pellets fired. The pattern is satisfactory if the percentage obtained is not less than that given for the barrel used in the following table:—

Type of barrel	Percentage
True cylinder	.. 40
Improved cylinder	.. 50
Half choke	.. 60
Full choke	.. 70

After one barrel has been tested the sheet, with the average and percentage noted on it, is taken down and kept as a record, and a new sheet is used to test the other barrel if a double-barrelled gun is being used.

Though three shots are sufficient to show average performance of a barrel and are therefore a fair test, gunmakers are not content with fewer than six shots. Sometimes they find it necessary to spend many days testing and regulating bores to get a desired pattern for a special customer. In such a case the cost of the weapon is increased considerably. This is one reason why some guns are priced at more than £200, whereas others, much the same to look at, are as low as £40 or £50.

Choice of Shotgun

It is a mistake for a learner to attempt to use a high-grade close-pattern gun. Such a gun is for the expert, and its use would discourage a newcomer, as his proportion of hits would be low except on "sitters".

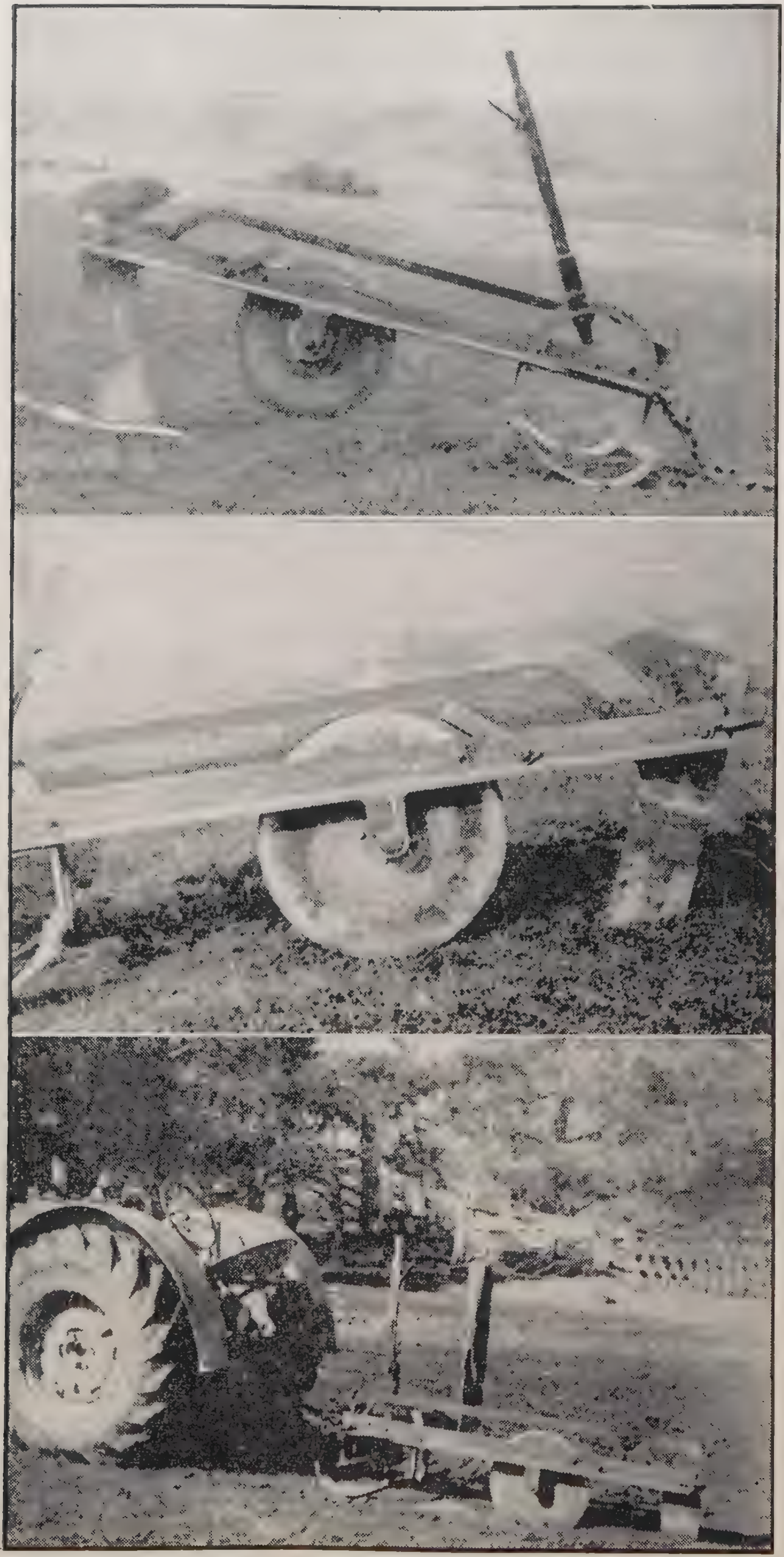
The gun recommended for a beginner is a hammerless gun of medium grade that is bored with a cylinder right barrel and a half-choked left. It must be realised, however, that barrels which are tight in their boring may be modified or "opened", but the reverse is not possible. In everyday use it is quite probable that much ammunition is wasted because the users do not realise that it takes a very high degree of skill to use a gun with full-choke boring in both barrels. Alterations to borings should be made only by a skilled gunsmith, as the operation is very delicate.

As with the .303 rifle, the shotgun should be thoroughly cleaned as soon after use as possible. A delay of 12 hours may cause blemishes to appear that are troublesome to remove. Hot water is the best medium to remove the salts left in the barrel and at least a quart of it should be poured through each barrel from the breech end, but care should be taken that none gets into the extractor groove. The barrels must be dried thoroughly and should then be lightly coated with petroleum jelly or gun oil. Patches, muzzle plugs, or so-called barrel preservers are useless and unnecessary and may lead to a damaged or burst barrel. The barrels should be wiped out before the gun is loaded again.

SIZES OF SHOT PELLETS

Actual size of shot	Size number	Number of pellets to oz.	Game used against
●	2	120	Geese, swans, and goats
●	3	140	
●	4	170	
●	5	220	Hares, rabbits, ducks, opossums, shags, pheasants, and hawks
●	6	270	Clay birds and magpies
●	7	340	Quail and blackbirds
●	8	450	

MOLE-DRAIN PLOUGH MODIFIED



WITH increasing use being made of mole drains, any method of improving the efficiency of their installation will be of interest to many farmers. On these pages H. A. Arthur, Fields Instructor, Department of Agriculture, Timaru, describes and illustrates simple modifications to a mole-drain plough which enabled a farmer to operate the outfit by himself and carry out drainage and water reticulation with a minimum of time and labour.

TWO main factors limit the amount of mole drainage carried out on New Zealand farms: The usual mole-drain plough requires two men for efficient operation, and on many farms the tractor is not powerful enough to pull the mole plough at the depths required for major drains, necessitating drawing drains at shallower depths and joining them by hand. A farmer in a foothill district in South Canterbury has overcome both these disadvantages ingeniously by three simple modifications of his light to medium-weight mole-drain plough. These modifications were made with the objects of lightening the draught and of making it possible to operate the plough with only one man, the tractor driver.

Effect of Skeith

To achieve the first objective a swamp-plough skeith was fitted to the plough half-way between the skids and the blade. This skeith runs between the two angle-iron frames of the plough, the bearings being welded to the undersides of the frame. The only structural alteration was to arch the rod actuating the wedge so that it cleared the upper edge of the skeith.

By the addition of this skeith two important results were achieved: Not only was the draught lightened considerably, but practically no trash now accumulates on the cutting edge of the blade. On a mole plough without a skeith trash frequently accumulates round the cutting edge of the blade directly under the beam, forcing the plough out of the ground and causing loss of fall in the mole drain.

The fitting of a skeith is not a new idea, as it has been developed in other districts, and it has some disadvantages, mainly the tendency of the skeith to lift the plough out of the ground when rushes or other obstructions are hit. However, this is only a minor disadvantage and sharp rises or falls on the surface should be avoided or smoothed off if the mole drain is to be made on a constant fall.

Upper left—The modified plough in the transport position, showing the methods of attaching the skeith and of raising the beam on the skids. Middle left—The position of the blade as it emerges gradually from the ground. The lever is fully back and the wedge in the bottom notch. Lower left—The plough in the operating position. The lever is half-way forward; by pulling it further forward the plough can be sunk in to the beam.

FOR OPERATION BY ONE MAN

To convert the plough to one-man operation two simple modifications were made. First, the skids originally fitted were attached to cross-bearers bolted directly to the frame; four short legs were fitted to the skids, raising the beam of the plough 6 to 8in. above the original height. Second, a strip about 1in. wide was cut from the underside of the blade, which bears against the wedge; the cut was not made the total depth of the bearing face, about 2in. of the original bearing face being left to clamp down on the wedge. These two alterations had a remarkable effect on the operation of the plough.

Before these alterations were made it was necessary to lift the blade from the ground at the end of a run, and for transport the lever was pulled right forward, disengaging the wedge and allowing the blade to swing right over. To make the torpedo re-enter the ground the tractor was backed slightly, the beam of the plough lifted, and the blade swung back under the beam far enough for the wedge to be re-engaged in the notch.

With the modified plough the blade is always in the down position and the driver does not need to leave the seat of the tractor. For transport the lever is pushed hard back, engaging the wedge in the lower notch. This is the normal position in which a standard plough would be set to make the torpedo enter the ground, but raising the front of the beam above the skids has altered the set of the torpedo, which does not dig in but runs along the surface.

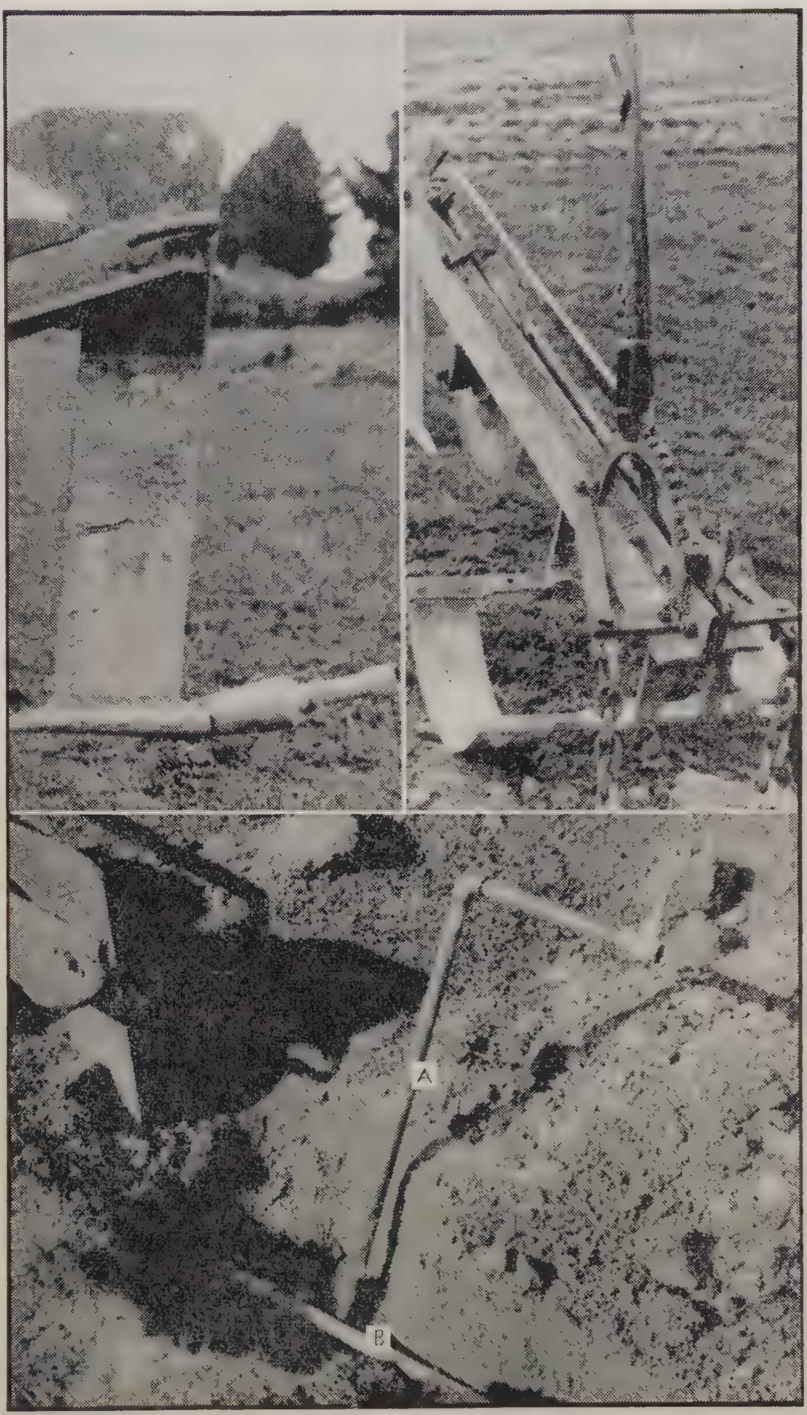
Lowering and Lifting

To make the torpedo enter the ground the lever is pulled forward far enough to disengage the wedge. When the tractor is moved forward the blade tilts back, allowing the torpedo to get a grip, and it pulls in until the top edge of the bearing surface comes to rest on the wedge governing the depth.

To lift the plough the tractor is backed against the front edge of the plough beam (on this outfit the drawbar is the same height as the beam, but it would be simple to fit an overrider to suit any drawbar height) until the wedge has enough clearance to enable it to be pushed into the bottom notch. When the outfit goes forward again the torpedo rises to the surface in a gentle grade in 6 to 8ft.

Laying Water Pipes

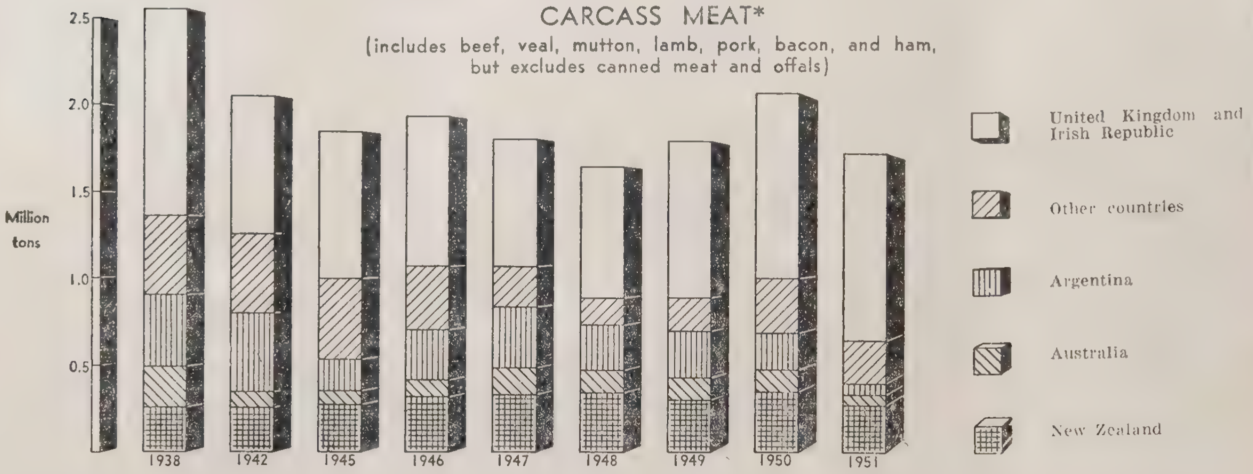
When this modified drain plough was demonstrated it was pulling in galvanised-iron water pipes for the reticulation of the farm. The farmer had fitted a fuse or pipe-union assembly to the back of the mole plug, ending in a screwed pipe socket into which a length of water pipe could be screwed. The tractor pulled forward the length of the attached pipe and another length was then attached, several lengths being pulled in at one operation. When the load became too heavy a hole was dug, the pipe disconnected from the fuse, and another start made by screwing a new length to the fuse.



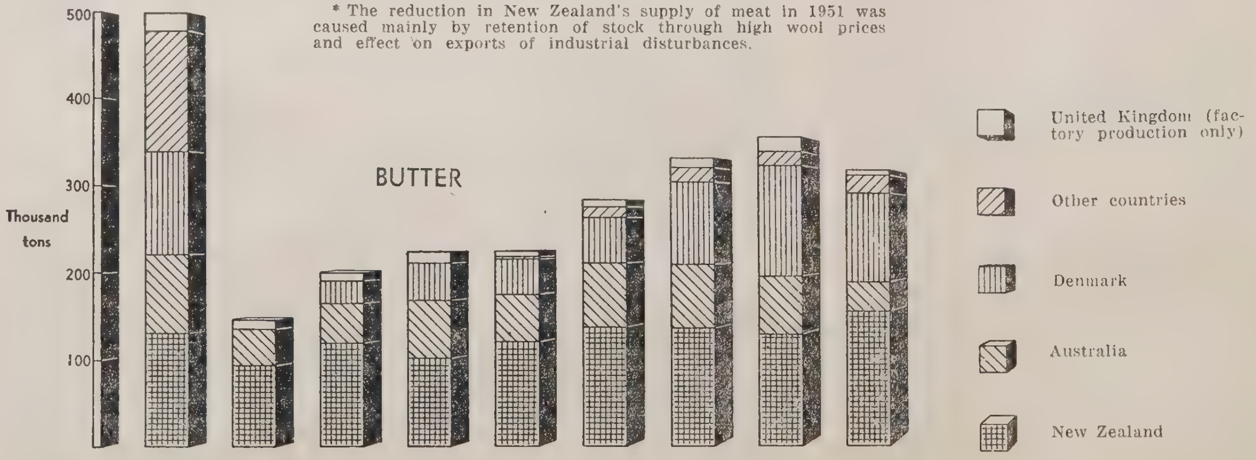
Upper left—The blade in the raised position for transport. Above the wedge is where a strip was cut off the top of the blade. A fuse has been fitted to the plug for drawing water pipes. Upper right—A front view showing the method of attaching the skids. Lower—Pipe A has been pulled as far as the site of a trough, and another line of pipes (B) has been screwed to the fuse on the plug ready to be pulled to another position. Several lengths of pipe can be pulled in at one operation

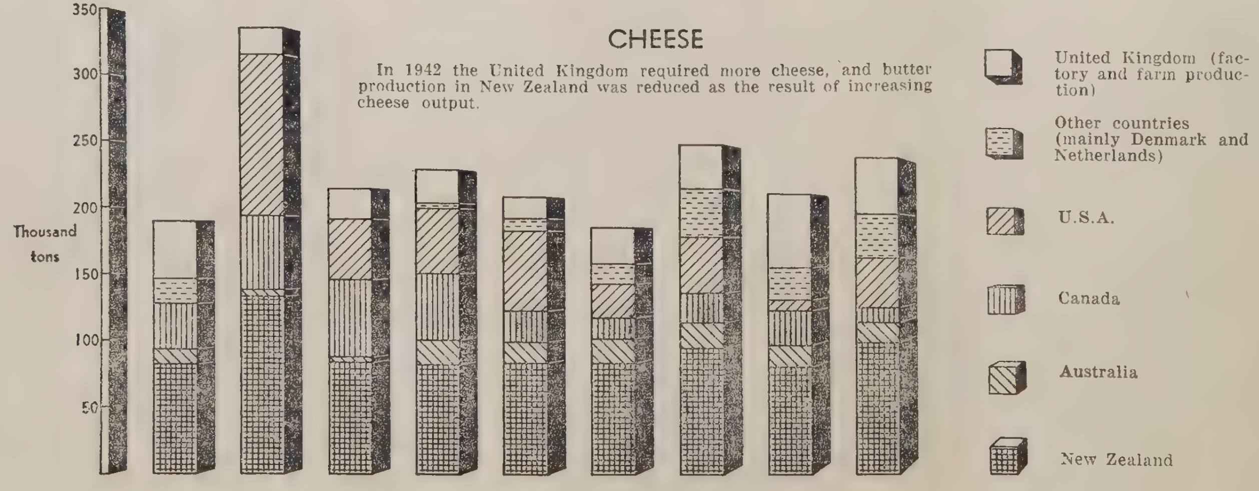
The United Kingdom's Food Supplies

The following diagrams, prepared by the Statistical Section of the Extension Division of the Department of Agriculture, show the sources of the United Kingdom's supplies of meat, butter, and cheese available for consumption in pre-war and in recent years. These diagrams are based on figures obtained from publications of the Commonwealth Economic Committee.


CARCASS MEAT*
(includes beef, veal, mutton, lamb, pork, bacon, and ham, but excludes canned meat and offals)

* The reduction in New Zealand's supply of meat in 1951 was caused mainly by retention of stock through high wool prices and effect on exports of industrial disturbances.


BUTTER


CHEESE

In 1942 the United Kingdom required more cheese, and butter production in New Zealand was reduced as the result of increasing cheese output.

Type of stationary spray nozzles in operation. Hope, Cross, and Richardson photo.

Irrigation of Horticultural Crops

By L. R. RENOUF, Horticultural Instructor, Department of Agriculture, Auckland

SPRINKLER irrigation, which can be adopted for practically all conditions under which horticultural crops are grown in New Zealand, is dealt with in this article, the first section of which appeared in last month's "Journal". It is the only method by which efficient irrigation can be carried out on very porous soils, on slopes with erodible soils, on soils with rough surfaces and too shallow to permit a minimum of levelling, and where the flow of water is too small to carry out surface irrigation.

ALSO where conditions are favourable for surface irrigation, but the water requirements are low and small applications only are required, sprinkler irrigation is the most practical method. Advantages will be gained in vegetable production when frequent light applications are required in dry periods, particularly for seed germination and when plants are young and shallow rooted.

With sprinkler irrigation water is forced out under pressure and, with few exceptions, this involves pumping of water from streams, wells, or dams.

Requirements for a successful sprinkler irrigation system are uniform distribution of water at the proper rate for the specific conditions at a reasonable total cost. A number of systems are available and in use and each has advantages. Factors in making a decision on the system to install are:—

1. Quantity of water available
2. Position of water supply
3. Shape of property
4. Absorption rate of soil
5. Crops to be irrigated
6. Time available to irrigate.

The sprinkler systems used in New Zealand are of the portable or semi-portable types, all or part of which can be moved from place to place over the area to be irrigated.

Overhead sprinkler system of irrigation used on an 8-acre block of raspberries.

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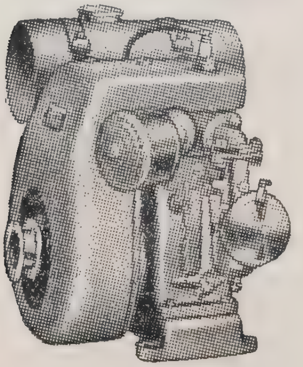

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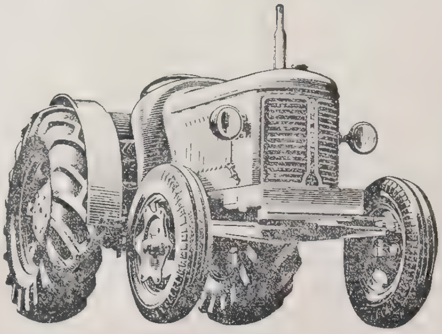

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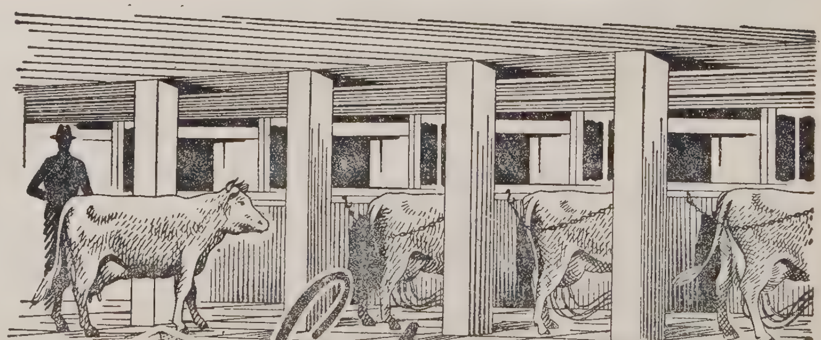

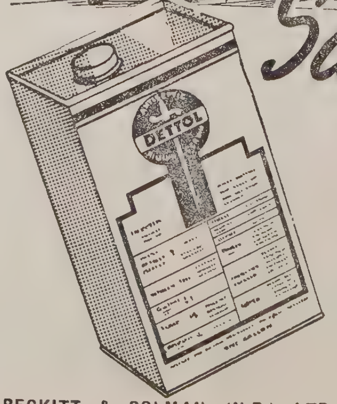

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The systems comprise a pump, motive power, and main line for delivery to lateral spray lines fitted with spray nozzles or to large single spray units. In some instances a main line run direct from the pump is used as a spray line.

Pumping and Motive Power

The volume of water and the pressure required determine the capacity of the pump necessary. The type of pump will be governed by the nature of the water supply. Except where abnormal lifts are required, one of the several types of centrifugal pumps will be found most suitable for irrigation purposes.

The selection of the type of motor will depend on the system installed. Where electric power is available and cost of operating the irrigation system is not too high an electric motor is a very desirable source of power. Stationary petrol and diesel motors are available to suit most irrigation schemes. The use of the farm tractor for motive power is very often the most practical method.

The power required will be determined by the total lift from water-level to the highest point of water delivery, the friction loss in pipes and spray heads, the volume of water and rate of flow, pressure required, and the efficiency of the pump.

In selecting the pump and motor for irrigation systems an engineer's advice should be obtained.

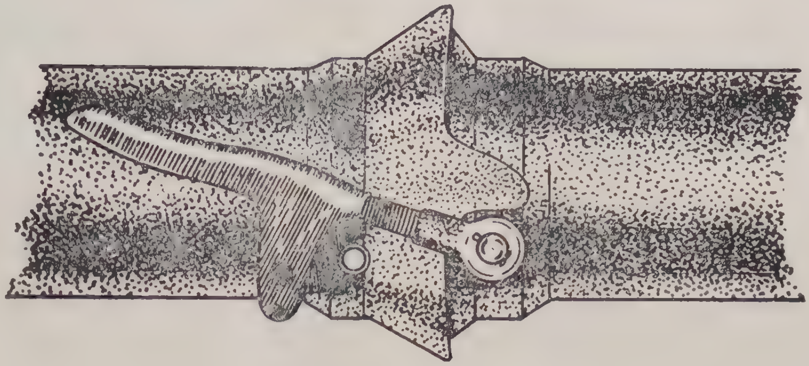
Location of Pumping Plant

When only one water supply point is available and the nature of the ground makes movement of the pumping plant difficult a stationary plant is more satisfactory.

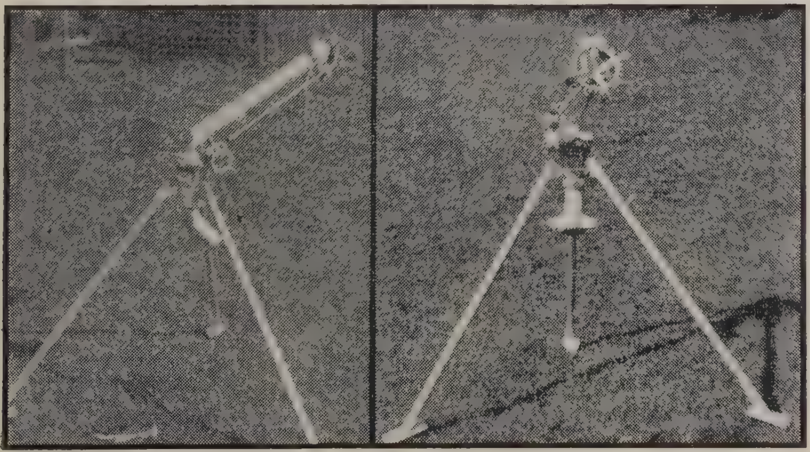
If water is to be pumped from a well and the lift from water-level to the surface is too great and necessitates the pump being installed within the well, permanent installations are advised.

With stationary pumping plants adequate protection from weather is essential when they are not in use.

Where more than one water supply point is available on the area to be irrigated, such as where a stream or race runs through or alongside the property or where two or more wells are available, the use of a wholly portable pumping plant will reduce the quantity of equipment necessary.



Upper and lower illustrations: Types of quickly manipulated couplings on light-weight pipes.



Single jet rotary sprayer.

Portable pumping plants are available in small sizes fitted on wheelbarrow frames which can be shifted readily by one man and in larger sizes mounted on trailers which can be towed by tractor or truck.

Where only one water point is usable and access to this is easy portable units should be considered, as after each irrigation is completed the plant can be taken in and stored under cover. This eliminates the necessity of building a special pumping shed.

Pipelines

The main lines delivering water to lateral spray lines can be either permanent or portable. Permanent lines can be under the ground or on the surface. For underground mains asbestos cement piping is very suitable. Hydrant controls at intervals (depending on spray coverage) would be fitted to permanent mains to connect spray lines.

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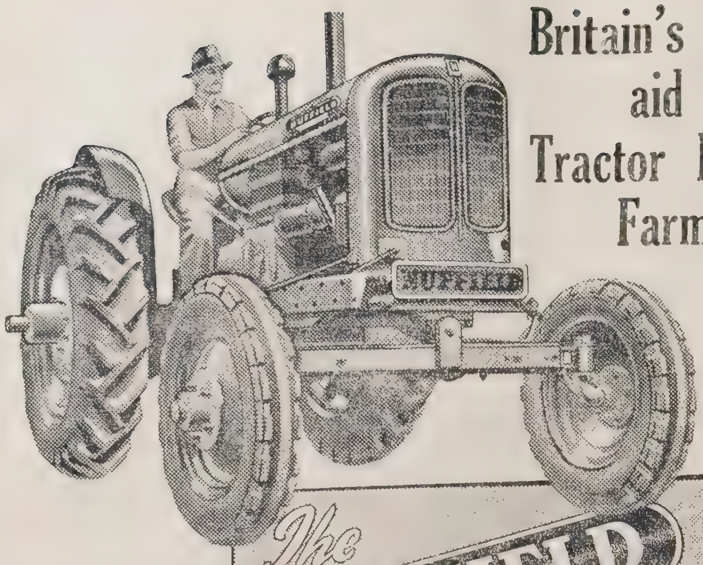

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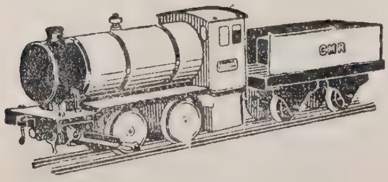

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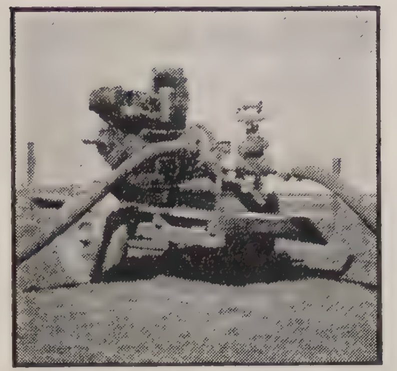
Permanent mains cost more to install than portable mains, but once they are installed labour at each irrigation is reduced. Portable spray lines are connected to the hydrant on the main lines. Spray heads or nozzles are fitted to the spray line at spacings judged by type of water spread.

Portable pipes are of light-weight material fitted with special couplings which allow some flexibility and quick coupling or uncoupling.

The most common pipes in use are made of 22-gauge galvanised iron. Although light to handle, they are sufficiently strong to withstand the necessary pressures and the handling they receive. Such pipes have been in use in New Zealand for years and are still in good condition. Tests carried out with them showed that 3in. pipe would stand 170lb. pressure to the square inch, 4in. 150lb., and 5in. 130lb. These pressures are considerably higher than any likely to be used. Aluminium pipes are also used in irrigation. These are very light and durable and will stand high pressures, but at present cost more than 22-gauge galvanised iron pipes.

Manufacturers of aluminium pipes claim that: 3in. pipe with wall thickness of 0.50in. will stand 300lb. pressure to square inch; 4in. pipe with wall thickness of 0.54in. will stand 240lb. pressure to square inch; 5in. pipe with wall thickness of 0.62in. will stand 220lb. pressure to square inch.



Trailer-mounted portable pumping unit.

Portable irrigation piping is made mainly in lengths of 17ft. 6in. to 20ft. and sizes of 2in., 3in., 4in., and 5in. The pipe lengths to be used will depend on the spacing of the lines for the type of spray head used.

Mounting the pipes on stands lends to convenience of handling and is desirable in irrigating taller-growing crops. The spray heads must be high enough to prevent any interference with water delivery. With some of the taller-growing crops it may be necessary to use stand pipes from the spray lines as well as stands to raise the spray heads above the plants.

In some small areas where water supplies are very limited or where the size of the area is a factor, it may be necessary only to use quantities of water which could be applied more economically through smaller pipes. In these cases permanent mains of stand-gauge water piping, with controls at intervals and with hose connections to one or more sprinkler units, would be the most practical.

The efficient operation of a sprinkler system depends on the sizes of pipes used. They must carry the required flow of water and leave a sufficient pressure for satisfactory operation.

Friction between pipes and water causes pressure losses. This loss with a given flow of water increases as the length of pipe increases and as the diameter of the pipe decreases. Sharp angles and sudden bends greatly increase friction.

Additional pressure is required at the pump to overcome these losses. This means that more power is required. Therefore the smaller the loss in the pipelines the lower the power requirements and operational costs.

To ensure even distribution of water from the spray heads and full use of the water available, pressure throughout the system must be controlled within reasonably close limits. This

BELOW: Low trajectory sprinkler nozzles in operation. R. W. Orr photo.

Dual nozzle rotating sprinklers in operation.

cannot be achieved if the size of pipes used is unsuitable.

For sprinkler irrigation of horticultural crops in New Zealand quantities of water from 200 g.p.h. to 15,000 g.p..h. are utilised. There is also considerable variation in the length of piping necessary and in the heights water has to be pumped. Pipes from 1in. to 4in. are used, but it is not possible to make general recommendations on the most economical size to install.

The importance of obtaining advice before installing pipelines cannot be too strongly emphasised.

Sprinkler nozzles

Nozzles or spray heads are manufactured in many different designs. Each is made to operate most satisfactorily at certain pressures and discharge rates.

1. **Stationary nozzles:** These are generally screwed on to tapped pipe couplings on portable pipes and can be removed. Some are fitted permanently on the pipe itself. A number are made so that the rate of output and spread can be varied, but most are a set type with pressure variations only.

Rose-type heads with holes drilled at regular intervals are common; some discharge from one hole and the adjustable type generally has a threaded valve screwed into the sprinkler head and discharge is from between the valve seat and valve.

The majority of these nozzles distribute water over a circular pattern, the diameter of spread varying from 20ft to 35ft. and a few to 44ft.

One system available in New Zealand spreads water over a square area, 35ft. x 35ft. being covered by each nozzle.

Stationary nozzles are operated best at low pressures, from 10lb. to. 20lb. to the square inch.

Rate of output from these nozzles varies from about 1 to 10 gallons per minute and rate of application of water from ¼in. to 2in. per hour.

From the nozzles water is ejected several feet into the air. Irrigating by this method is satisfactory for all horticultural crops with the exception of deciduous orchards.

In irrigating pip and stone fruit orchards it is advisable to keep the water off the fruit and foliage to prevent the possibility of increasing the incidence of disease and cracking of fruit.

Sprinkler nozzles that have a low trajectory and throw the water only 2ft. to 3ft. high are used for this purpose. The types made are adjustable and cover circular areas from 20ft. to 35ft. in diameter and discharge from 2 to 4 gallons per minute at pressures from 10lb. to 25lb. to the square inch and apply 1/3in. to 1in. of water per hour.

2. **Rotating sprinklers:** Several types of rotating sprinklers are used for irrigation of horticultural crops. These, in general, cover much larger circular areas than the stationary sprinklers. They are manufactured in a range of sizes that allow for usage at pressures from 15lb. to 100lb. to the square inch and for utilising volumes of water from 2 to 200 gallons per minute. Circular areas covered vary from 50 to 300ft. in diameter. Larger units than this are available, but these are more suitable for pasture irrigation than for horticultural crops.

Rotating sprinklers have gained favour in irrigation in America and Australia and are now becoming more commonly used in New Zealand.

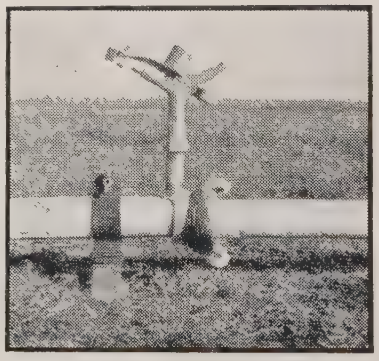
Slowly rotating sprinklers that make one or two revolutions per minute are most popular. Under most conditions advantages are gained over fast-rotating sprinklers in that:—

The slower the revolutions the greater the area covered. This is important, as the spacing of sprinklers can be increased.

Less water per hour to the area irrigated is offered. On soils that have a slow water absorption rate and on erodible soils or slopes slow application is essential.

Slow rotation saves wear.

Suitable rotating sprinklers are of two types, the dual nozzle jet spray head and single jet sprays.



Type of dual nozzle rotating sprinkler.

	Pressure lb. to sq. in.	Nozzle size (in.)	Discharge in g.p.m. imperial gallons	Coverage diameter (ft.)	Approx. rainfall in 1 hour (in.)
No. 1 make Model A	15	⅛	2.7	70	0.08 to 0.12
	25		3.5	75	
	35		4.2	80	
	20		4.1	75	
	30	5/32	4.9	85	
	40		5.7	90	
	25		5.7	85	
	35	3/16	6.7	90	
Model B	30		10.2	105	0.13 to 0.17
	40	7/32	11.7	110	
	50		12.9	115	
	35		12.9	110	
	45	¼	14.7	115	
	60		17.0	120	
	40		16.2	120	
	50		18.1	125	
	60	9/32	19.8	130	
No. 2 make Model A	15	3/16 to ⅛	4	64	0.14 to 0.24
	20		4.7	71	
	15		6.7	57	
	20	15/64 to 11/64	7.7	65	
	25		8.6	72	
Model B	30		7	83	0.14 to 0.17
	40	3/16 to ⅛	8	90	
	50		8.5	95	
	30		12.6	95	
	40	¼ to ⅛	14.5	105	
	50		15.5	113	

Dual Nozzle Rotary Jet Spray Head

The dual nozzle rotary jet spray is of two types. The first is the oscillating spring type, which has a pivoted impact arm attached to a coil spring. The water issuing in a jet from one nozzle impinges on the inner surface of this arm, forcing the arm to swing away from the jet, which then has uninterrupted carry for a short period. The spring forces the arm back and the impact of the arm on the stop, which may be a special extension or the spray head itself, causes the head to move partly around. Repetition of the arm movement imparts the rotary action of the spray head.

The second type of dual nozzle spray head is rotated by the reaction of the jets and is fitted with vibrators for slow rotation.

The operation of dual nozzle spray heads is that one nozzle waters the outer ring of the circle and the secondary nozzle, which may have a small projection to break off the spray, waters the inner ring.

Different makes of the oscillating spring type vary the position and shape of the impact arm, some having the main jet impinging on this and others the secondary jet.

Dual nozzle spray heads are designed with replaceable nozzles so that changes from one size jet to another can be made readily. Different performances can be obtained from each model by varying the nozzle size and adjusting the pressure to suit each size. The larger the nozzles the higher the pressure and the greater the volume of water required for maximum performance.

The table on the previous page illustrates some of the performances that can be obtained with these changes.

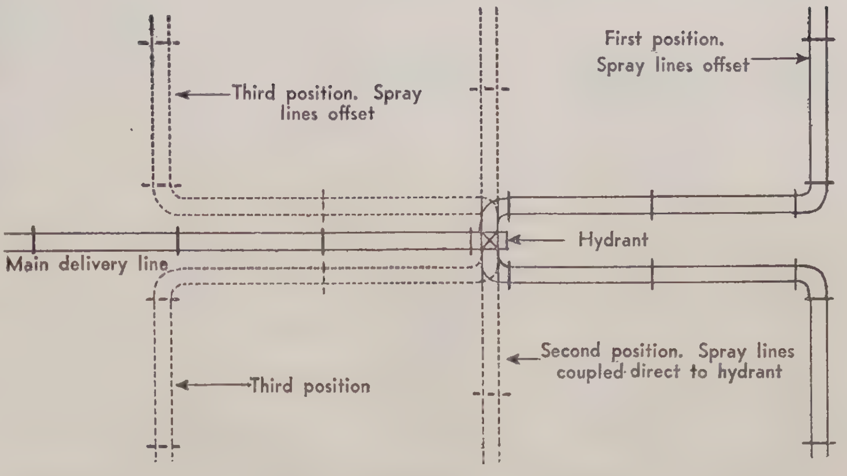
There are other makes and different models of this type of sprinkler head, but the principal ones come within the range shown.

Dual nozzle rotating sprinklers are suitable for use in multiples on spray lines or as single units where the volume of water available is limited.

Single Rotary Jet Sprays

Single rotary jet sprays are single units designed on stands and connected to a delivery line. They are made to cover much larger areas than the type previously described, and higher pressures and greater volumes of water for each are required. They cover circular areas varying in size according to pressure and nozzle size.

The rotary action of this spray is gained from the water jet impinging on a flywheel fixed close to the jet. This action also breaks up the jet into various degrees of fineness according to the extent to which the jet impinges on the flywheel.


First position.
Spray lines offset
Third position. Spray lines offset
Hydrant
Main delivery line
Second position. Spray lines coupled direct to hydrant
Third position

Spray lines offset to allow three positions to be irrigated from the one hydrant position without shutting off the pump.

An idea of the requirements and performances of these sprays can be gained from the table on this page.

Larger units discharge up to 400 g.p.m. at 100lb. pressure and, covering areas up to 2½ acres, apply 0.3in. to 0.5in. of rain in 1 hour.

Nozzle Line Sprinkler System

Another form of sprinkler irrigation is a perforated pipeline with small nipples fitted in each perforation from 2ft. to 4ft. apart. This line is connected to a delivery main which is generally permanent.

The spray line is supported at a suitable height above ground and the whole line is rotated on the supports. The nozzles are all on one plane and all jets emerge parallel to one another and at the same angle.

This system has not been used to any extent in New Zealand, and on the few installations, turning the spray lines by hand is relied on to obtain coverage. In overseas countries where greater use is made of this system automatic oscillators are fitted to rotate the lines.

The performances of the spray line vary with pressure changes and the system can be used over a wide range of pressures. It is generally operated at 15 to 40lb. pressure which allows nozzle discharges of from 0.15 to 0.25 gallons per minute and covers strips 15ft. to 25ft. on each side of the line.

Spacing of Sprinklers

Reasonably uniform application of water can be assured only when the correct spacing of sprinkler heads is adopted.

In irrigating orchards by the use of low trajectory sprays, even though they may have a coverage of 35ft. diameter and tree spacings are 18ft. to 20ft., it is necessary to operate the spray line on each row to assure complete coverage. With young trees satisfactory irrigation may be effected by operating the line in every second row. Sprinkler heads spaced one to each tree space in the row are necessary.

Under ideal conditions heads covering a square area give good over-all coverage spaced at intervals equal to their spread Where winds are troublesome it has been the practice to space the heads on the spray lines at intervals of half the spread. The spacing between positions of the spray line would be equal to the total spread. The rate of application in this case is doubled and half the time is necessary to apply a given quantity of water.

With sprinkler heads covering circular areas some overlap is essential to obtain satisfactory coverage. The extent of the overlap necessary will depend on the distribution patterns of the heads, most of which are designed for set spacings.

One type of sprinkler distributes water in varying concentrations from the centre to the outside edge of the circle while others apply water reasonably uniformly over the whole area.

For the first type close spacing is necessary to obtain reasonably even distribution and several methods of layout are adopted. Sprinkler heads are spaced a third to half of the diameter of the spread on the spray lines and up to the full diameter between lines.

To keep the number of shifts per acre of an irrigation system to a minimum, sprinklers giving reasonably even coverage of the whole spread are necessary. By spacing these on a triangular pattern up to about four-fifths

	Pressure lb. to sq. in.	Nozzle size (in.)	Discharge in g.p.m. Imperial gallons	Coverage diameter (ft.)	Rain in 1 hour (in.)
Model A	55 to 85	½	34 to 42	148 to 159	0.23 to 0.25
		9/16	55 to 66	174 to 190	0.26 to 0.27
		⅝	70 to 86	190 to 212	0.27 to 0.29
		23/32	86 to 110	204 to 232	0.29 to 0.31
Model B	55 to 85	25/32	105 to 155	240 to 262	0.29 to 0.34
	70 to 100	⅞	160 to 200	272 to 288	0.33 to 0.36
		15/16	190 to 225	288 to 300	0.34 to 0.46

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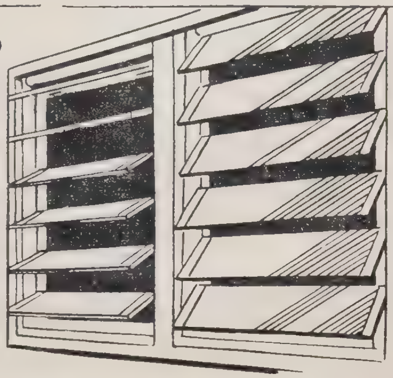

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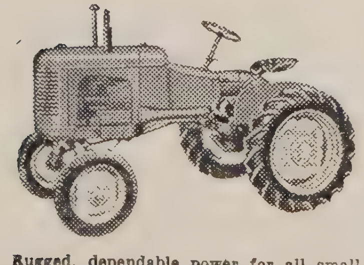

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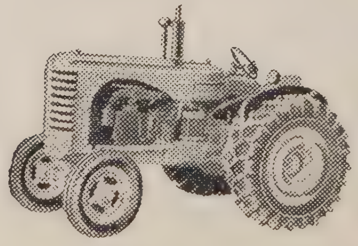

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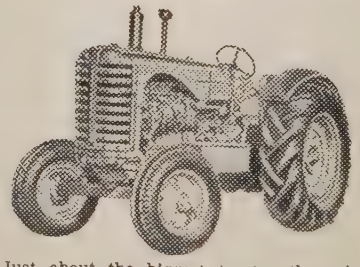

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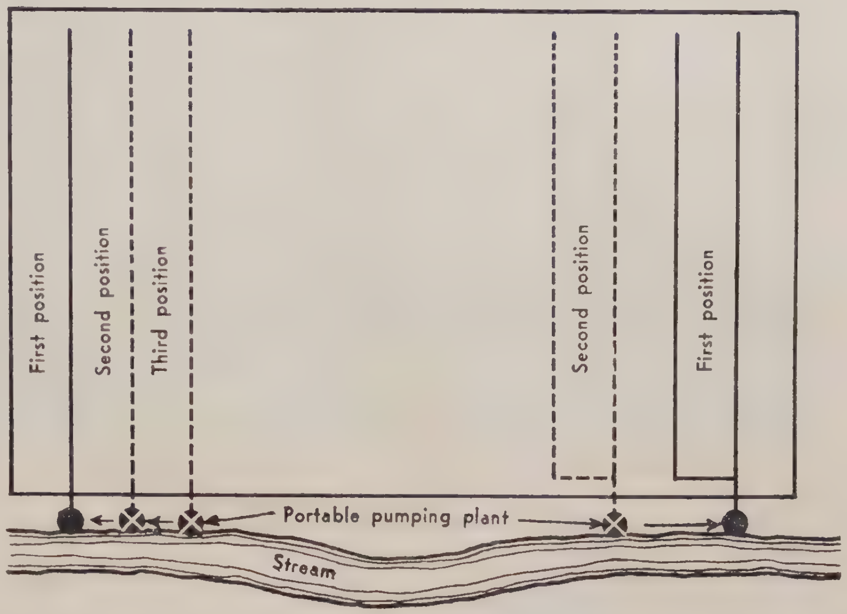


Portable pumping plant operating single and double spray lines.

the diameter of the spread apart on the spray line and the same distance between lines the minimum of overlap is obtained and under calm conditions satisfactory irrigation will be achieved.

Spacing of sprinklers on portable systems will be in multiples of pipe lengths and this must be taken into account when selecting sprinklers.

Sprinklers giving a spread of 80ft. diameter could be spaced 3 pipe lengths apart, which would be 60ft. for 20ft. pipe lengths, 54ft. for 18ft. lengths, and 52½ft. for 17ft. 6in. lengths.

Sprinklers giving a spread of 90ft. diameter could be spaced at 4 pipe lengths apart for 17ft. 6in. and 18ft. lengths, but 3 pipe lengths for 20ft. long pipes. This gives spacings of 70ft., 72ft., and 60ft. respectively.

Wind influences the distribution pattern of sprinklers and under windy conditions a greater overlap is necessary to assure coverage. With portable sprinkler systems and single-unit sprinklers the spacings can be varied readily to suit all but extreme conditions, but with permanent installations wind is a serious problem.

Layout of Portable Systems

The arrangement of an irrigation system will be determined by the size and shape of the property to be irrigated, the location of the water supply, the volume of water available, and the time allowable for irrigation.

Each system must be designed to meet specific requirements and to operate efficiently at reasonable costs for equipment, power, and labour.

Where water supply is from a stream or race running along the property and easily accessible at all points, a portable pumping unit to which a single spray line is attached can be used. When the desired quantity of water has been applied the pump is shut down while it and the pipes are shifted to the next position. This involves loss of sprinkling time, but it is practical for small areas. More than one spray line could be operated from the same system.

Where only one water supply point is available a main delivery line is necessary to feed the spray lines. Single spray lines can be operated from the main, but the most efficient arrangement is the use of multiple lines, one on each side of the main. By the use of a twin outlet hydrant on the main the control of the water supply to each lateral is independent; while one line is being moved the other continues to operate. This means that the pumping unit is in continuous operation.

By offsetting the laterals three positions on each side of the main can be irrigated before moving to the next hydrant or, where one hydrant is used, the main line may be shortened and the hydrant installed at the next position.

On permanent delivery mains hydrants must be fitted at appropriate intervals, but with portable mains one hydrant will allow of efficient operation in most cases, although the pump is shut off each time the hydrant is moved.

Where two or more water points are available the system of portable main and multiple laterals described can be operated in each area adjoining the points. This reduces the amount of equipment required.

An ideal set-up for sprinkler irrigation is where a well water supply is situated in the centre of the block to be irrigated. The main line required is half of that required when the water supply is situated at the outside of the property. When one end of the block has been irrigated the system can be transferred to the other end. When the capacity of the pumping plant is insufficient for operating two spray lines, the loss in pumping time will be reduced by having the two lines and operating them alternately.

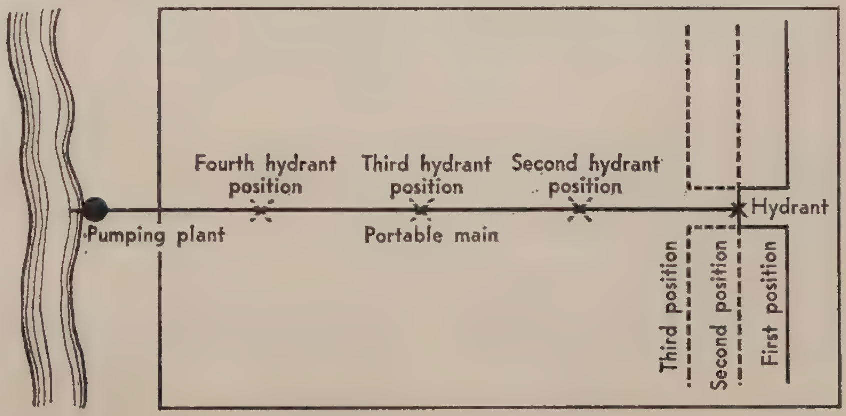
The distance spray lines are shifted at each move will depend on the spread of the sprinkler heads used. Labour will be reduced by using sprinkler heads giving wide coverages, as fewer shifts of the spray line are necessary to cover the area.

On sloping land spray lines should, as far as possible, be run along the contours. This minimises pressure variations and avoids run-off and erosion that are likely to occur if lines are run up and down the slopes.

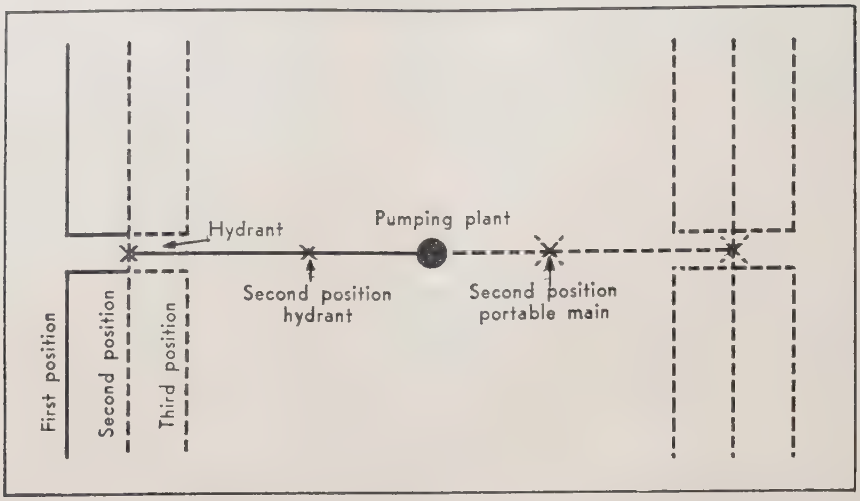
Evaporation

Losses occur in sprinkler irrigation with evaporation of spray in the air, particularly during daytime irrigation in high temperatures. The extent of this loss depends on the fineness of the spray. Overseas investigators have shown this loss is in the order of 2 per cent. provided the spray remains in drops, and it increases as the spray becomes more misty.

Evaporation from the soil surface will occur regardless of how water is



Water supply outside area to be irrigated. Multiple spray lines, showing three positions from each hydrant position. If the system is permanent, main hydrants are at the required intervals. If the system is portable, one main hydrant is shifted after every three positions watered.



Water supply in centre of property. Portable main line is shifted from end to end.

applied, but overhead sprinkler irrigation also wets the foliage of crops and further losses will occur from evaporation from these surfaces.

Scorching of Fruit or Foliage

Scorching due to wetting of foliage and fruit during hot weather is liable to occur on some fruits and plants. Lettuce near the full heart stage are liable to be damaged. Some small fruits and sub-tropical fruits have been found to show scorch from sprinkling and under certain conditions other plants may be damaged.

With crops susceptible to injury in this manner consideration should be given to irrigating these at night, when conditions are more appropriate to those accompanying natural rain.

Spray Removal and Incidence of Disease

The irrigation of pip and stone fruit by overhead sprinkling is not considered advisable because of spray being washed from the trees and the possibility of aggravating fungous disease and causing cracking of fruit by moistening the foliage and fruit.

Use of Strainers

Where water is pumped from streams or dams foreign matter is likely to enter the system. Strainers or screens should be used, particularly when rose-type sprinkler heads with a series of fine holes are used.

Foreign material not only enters the pipes through the pump but also as the pipelines are being assembled. Irrigators should make a standard practice of flushing the pipelines before starting sprinkling operations.

Labour

The labour involved with sprinkler irrigation will vary quite considerably in different properties. It is estimated that on an average one man can uncouple, lay, and recouple 500ft. of portable piping and allied components in 1 hour and that 2 to 2½ man-hours per acre are required. On pasture lands the ground will be reasonably firm after irrigation and there are no obstructions to hinder the transfer of the system from one position to the next. With horticultural crops grown on cultivated soil the ground will be quite boggy immediately after irrigation and this fact together with having to transfer pipes between trees and plants will make for slower moving of the system. The spacing between spray lines governed by the spread of the sprinklers used also affects the labour involved in that the wider the spread the fewer are the shifts necessary on any area.

Costs

Horticultural crops are grown under such a wide diversity of conditions—size, shape, and level of property, soil type, crops grown, and situation of water supply—that there is a great variation in the capital costs of sprinkler irrigation systems and no fixed figure can be arrived at. Capital costs of systems have varied from £20 to £60 per acre and costs of operation also vary considerably.

The costs involved are the principal disadvantages of sprinkler irrigation, but in the growing of horticultural crops in areas where even short-term drought periods are fairly regular the additional returns from irrigation will compensate for fairly high per-acre costs.

Irrigation properly applied will increase development and production of horticultural crops, but it does not reduce the need for good cultural practices. Increased crops mean increased demands on the soil and the maintenance of soil fertility becomes still more important when irrigation is used. Highly fertile soils will need less irrigation and will produce greater crops per unit of water than infertile soils.

Radio Broadcasts

RADIO broadcasts to farmers will be given as follows during August:—

1YA Auckland, 7.15 p.m.

6 August—"Use of Hormones for Weeds in Pastures", by G. L. Banfield, Instructor in Agriculture, Department of Agriculture, Thames.

13 August—"Poultry Topics", by S. G. Haddon, Poultry Instructor, Department of Agriculture, Auckland.

20 August—Talk by D. G. Austin, Sheep and Wool Instructor, Department of Agriculture, Auckland.

27 August—Y.F.C. session, conducted by Rodney district committee of Federation of Young Farmers' Clubs.

1XH Hamilton, 12.33 p.m.

7 August—"Dehorning of Cattle", by D. W. Caldwell, Veterinarian, Department of Agriculture, Hamilton.

14 August—"Winter Crops for Pigs", by J. R. Murray, Instructor in Agriculture, Department of Agriculture, Hamilton.

21 August—"Current Farming Affairs", by A. W. Moore, Federated Farmers, Hamilton.

28 August—"Microbes and Agriculture", by R. E. Rose, Microbiologist, Department of Agriculture Soil Research Station, Rukuhia.

1YZ Rotorua, 7.15 p.m.

7 August—"Feed Flavours in Milk and Cream", by G. Purvis, Superintendent of Butter Instruction, Department of Agriculture, Hamilton.

21 August—"Spring Pasture Management", by N. A. Clarke, Assistant Fields Instructor, Department of Agriculture, Matamata.

2YZ Napier, 7 p.m.

5 August—"What Your Killing Sheet Shows", by J. H. Thornton, Supervising Meat Inspector, Department of Agriculture, Hastings.

19 August—"Seasonal Horticultural Notes", by C. L. Napier, Horticultural Instructor, Department of Agriculture, Hastings.

2ZA Palmerston North, 12.30 p.m.

4 August—"Seasonal Stock Notes", by W. W. Hubbard, Livestock Instructor, Department of Agriculture, Palmerston North.

11 August—"Lucerne Growing", by L. H. Alsop, Fields Instructor, Department of Agriculture, Dannevirke.

18 August—"Feed Flavours", by M. J. McFetridge, Special Inspector, Department of Agriculture, Palmerston North.

25 August—Federation of Young Farmers' Clubs' session, conducted by I. G. Tabor.

2XA Wanganui, 8 p.m.

21 August—"Planting and Rotation of Crops in the Vegetable Garden", by H. P. Thomas, Horticultural Instructor, Department of Agriculture, Wanganui.

3YA Christchurch

7 August (7.15 p.m.)—Review of "The New Zealand Journal of Agriculture", by E. G. Smith, Fields Instructor, Department of Agriculture, Rangiora.

18 August (12.20 p.m.)—"Establishing a Poultry Unit", by C. J. Goldsmith, Poultry Instructor, Department of Agriculture, Christchurch.

28 August (7.15 p.m.)—"Establishing a Hive of Bees", by F. Bartrum, Apiary Instructor, Department of Agriculture, Christchurch.

4YA Dunedin, 7.20 p.m.

13 August—"Cattle on the South Otago Sheep Farms", by J. Sheenon, Inspector of Stock, Department of Agriculture, Balclutha.

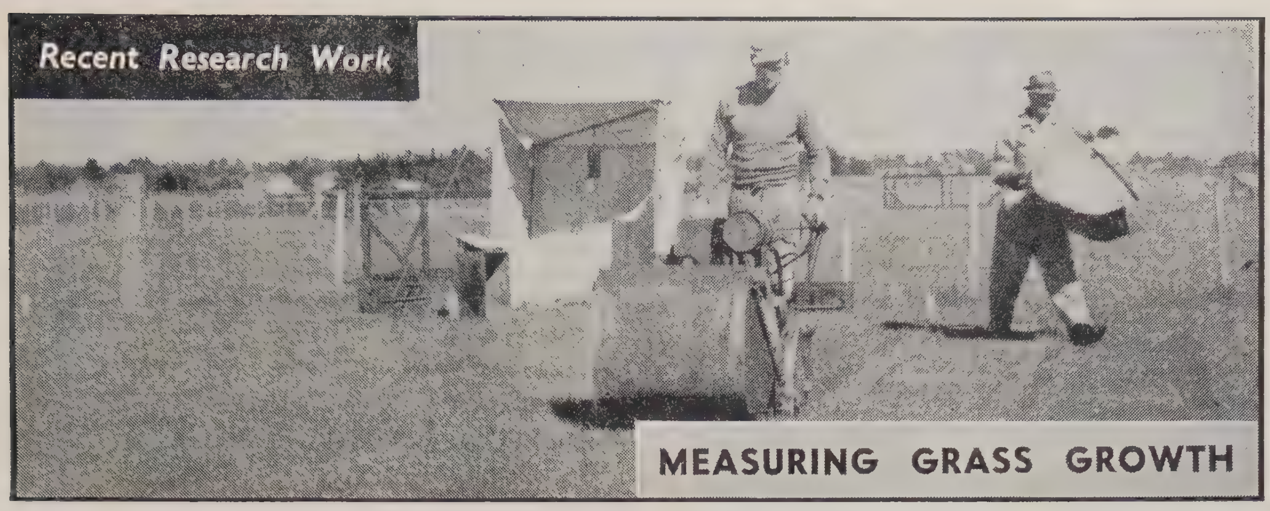
27 August—"Current Garden Work", by A. G. Kennelly, Horticultural Instructor, Department of Agriculture, Dunedin.

4YZ Invercargill, 7.15 p.m.

26 August—"Importance of Grain Growing", by W. Faithful, Fields Instructor, Department of Agriculture, Invercargill.

Other Broadcasts

1YA Auckland, Tuesdays at 12.35 p.m. and Wednesdays at 7.15 p.m.; 1YD Auckland, Thursdays at 7.30 p.m.; 1XN Whangarei, Mondays and Wednesdays at 8.10 p.m.; 2XA Wanganui, Thursdays at 8 p.m.; 2XG Gisborne, Tuesdays at 8 p.m.; 3XC Timaru, Wednesdays at 8.5 p.m.



Recent Research Work

MEASURING GRASS GROWTH

MEASUREMENT of grassland production is made difficult by several factors, most important of which are the effect of the technique used on the botanical composition of the sward and the necessity to use a cutting method which most closely resembles the effect of the grazing animal. On this page are described efforts made by the Extension Division of the Department of Agriculture to overcome those difficulties.

EFFECTS OF MANAGEMENT

PASTURES can be altered profoundly in species composition by changes in management: Close and continuous cutting or grazing encourages close-growing species such as clover and flat weeds, and too-long intervals between cutting allow smothering of these species and flourishing of tufty grasses such as cocksfoot. Further, within limits, the longer is the cutting interval the greater is the measured pasture production.

A trial at Marton Experimental Area showed clearly the effect on grassland production of different intervals between cuts. Over a 2-year period a 2-weekly interval between cuttings gave yields 35 per cent. above a weekly interval; a 3-weekly interval gave 57 per cent. and a 6-weekly interval 112 per cent. more production than that from plots cut each week.

BASIS OF COMPARISON BETWEEN DISTRICTS

SOME STANDARD PROCEDURE obviously is necessary if trials in different districts are to be compared. For measurement of total yearly production of grassland a variable interval is used, but plots are cut at the same stage of growth, usually that considered satisfactory for sheep grazing. For estimation of seasonal changes in production, on the other hand, cuttings are made at regular 2- or 3-weekly intervals so that the growth in low-production periods can be measured.

By this means data are being accumulated which will enable the estimation of normal or average seasonal and yearly pasture-production figures in a number of districts, as well as give an indication of variations in production that might be expected in different seasons and in different years. This information should be of considerable value in the planning of feed supplements for stock to meet low-production periods and in the assessment of efficiency of pasture utilisation by the grazing animal.

Productive capacity and special problems of each district studied are clearly shown. In the Waikato, for example, summer production is frequently lower than winter production, and low summer grassland production is a major factor limiting carrying capacity. On the other hand, at Winton in Southland summer production is frequently higher than in any North Island district, but growth from April to September is negligible. This marked difference in seasonal growth produces special problems in pasture utilisation and makes reliance on supplementary crops almost inevitable.

FERTILISER RESPONSES

A SERIES OF TRIALS at Rukuhia Soil Research Station and Marton Experimental Area has compared techniques of pasture-production measurement for efficiency in assessing responses of grassland to fertilisers. The techniques studied gave closely similar measures of fertiliser responses. A simple "mowing only and clippings returned" technique over a 2½-year period at Rukuhia gave almost exactly the same measure of response to superphosphate and superphosphate-plus-lime topdressings as did the more elaborate "frame" technique. In the "mowing only and clippings returned" technique the plots are not grazed and mown herbage is returned after being weighed to the plots which produced it. Most of these clippings rapidly become incorporated in the soil by the action of rain and earthworms, and a high-class sward can be maintained for a surprisingly long period. In the "frame" technique a number of separate paddocks under grazing is allocated to each fertiliser treatment, and pasture production is measured within each field by means of movable cages or frames which protect for short periods small areas for cutting and measurement of pasture production. Because these frames are moved about the trial paddocks, the area mown has produced herbage for the greater part of the trial period under normal grazing conditions.

The use of the simpler "mowing only and clippings returned" technique is enabling a much greater number of fertiliser mowing trials to be undertaken than would have been possible if the more elaborate "frame" technique had been found necessary.

COMPARISONS OF PASTURE TYPES

THE "FRAME" TECHNIQUE must be used, however, where different pasture species are being compared, so that the comparison can be made under the grazing management which best suits each type of pasture. The "frame" technique may be adapted to a range of types of grazing management.

It must also be used in most cases to obtain reliable measures of seasonal and yearly pasture production, because the "mowing only and clippings returned" technique, though giving an accurate measure of differences among treatments, underestimates the production of grassland under grazing as measured by the "frame" technique.

FUTURE WORK

BY NO MEANS ALL the problems of pasture-production measurement have been solved. One investigation still proceeding compares the mower as a cutting implement with cutting by hand with shears to ground level and with plucking the herbage by hand to correspond as closely as possible to the type of grazing in the surrounding field. Results to date indicate that mowing probably gives the most accurate sample of herbage for weighing: It is not biased in any way and it is the most rapid method. Where growth, grazing, or the surface of the ground is very uneven, cutting the herbage with shears by hand to ground level appears a useful alternative.

Most cutting techniques give underestimates of stock-carrying capacity in low-production periods, particularly in summer, and no reliable method has yet been devised to overcome this defect.

—P. B. LYNCH

Care of Livestock during August

Contributed by the Animal Research Division

CALF REARING

Calves should be fed their mothers' milk for the first 3 days. This is important, as the first milk, known as colostrum or "beastings", contains substances which increase a calf's resistance to scours. Since overfeeding is an important cause of this trouble, not more than 6 pints daily should be fed during the first week, 7 pints during the second week, and 8 pints during the third week. Diluting the milk ration with a quarter of its volume of water will also reduce the incidence of scours. If scours occur, a supply of a sulpha drug should be obtained from a Veterinarian immediately, as the drug is very effective when used promptly. Calves should not be kept in a calf paddock. When 2 to 3 weeks of age they should be rotationally grazed ahead of the cows. Alternatively, rotate the calves through a minimum of 5 cow paddocks, in which they should spend not more than 5 days at a time in any one paddock. Where good pasture is available calves can be weaned quite satisfactorily at 8 weeks. If whole milk is fed, there is no need to give more than 7 pints per day.

CARE OF THE CALVING COW

Cows about to calve should be brought into a handy paddock so that they can be kept under supervision. If a cow has difficulty in calving, veterinary assistance should be sought as soon as it is obvious that the presentation is not normal and in any case within 6 hours of the start of labour. Unskilled interference exhausts the cow and makes the Veterinarian's task more difficult or even impossible. Veterinary assistance should also be sought if the cow does not clean within 48 hours. Do not hang weights on the afterbirth.

FEEDING AFTER CALVING

Autumn-saved pasture is the best food for newly calved cows, but it must be grazed in small breaks which the cows will clean up in about 2 hours. The cows should continue to receive as much silage as they will eat and if the pasture is short and sappy, they should also receive hay.

SELECTION OF CALVES FOR REPLACEMENTS

The full sisters of high-producing heifers should always be kept, as should the daughters of Merit Sires with a high progeny test. Providing they are sturdy, the calves of very old cows with good life-time performances should always be kept, and there is no reason why the calves of well-bred heifers should not be kept. Twin heifers are seldom worth keeping and the twin of a bull calf should never be kept.

MASTITIS

Milk from each quarter should be examined with a strip cup before milking. If it shows any abnormality or if the udder appears inflamed, treatment with penicillin should be started at once. Three tubes should always be injected at 24-hour intervals, even if the milk appears normal after the first tube. Prompt treatment early in lactation will often save a quarter which otherwise might become weak or even blind.

STERILITY IN COWS

If difficulty was experienced in getting cows in calf last summer, now is the time to seek veterinary advice to prevent similar trouble this year. Control of trichomoniasis depends on using only clean bulls and not mating cows for several months after calving. It is, therefore, too late to do anything if action is deferred until the mating season starts.

LICE ON CALVES

Calves and yearlings may become very lousy during late winter and early spring. Control can be effected by the use of suitable dips, sprays, or washes, of which those containing D.D.T. or "Gammexane" are most effective. Repeated treatments may be necessary, as the eggs are difficult to destroy.

CARE OF LAMBING EWES

About 10 per cent. of all lambs are either born dead or die during the first week. These losses can be reduced by careful shepherding. Many lambs and some ewes can be saved by skilled assistance during lambing. Always use a reliable lubricating antiseptic on hands and wrists. Faulty presentations must be corrected. A lamb should never be forcibly pulled away when a leg or the head is turned back. A number of lambs die from suffocation through the cleanings remaining over their nostrils. These are very easily removed. Where necessary lambs should be assisted to get a drink. This is particularly important where ewes have very large teats. Drawing away a few squirts from these will reduce their size and enable the new-born lambs to suckle. Ewes with very large teats, very small teats, badly placed teats, or defective udders should be marked for culling. A big percentage of their lambs will die. Many lambs which die during cold or wet weather would survive if they got a good drink soon after birth.

WORMS IN HORSES

Red worms reduce the efficiency of farm horses. Drenching with phenothiazine now will prevent the pastures becoming contaminated with eggs and thus reduce the chances of reinfestation in spring. As phenothiazine causes very severe reactions in some horses, dosing should be done under veterinary supervision wherever possible. If this cannot be arranged, divide the dose recommended on the package into 5 parts and give it over 5 days.

DISEASES OF CHICKS

Navel disease is contracted in the incubator, which should be scrupulously cleaned and fumigated with formalin between batches of chicks. Pullorum disease can only be controlled by repeated blood testing of all stock, immediate disposal of all reactors, and thorough cleaning and disinfection of premises after each test.

Dairy Produce Graded for Export

The following figures showing quantities of dairy produce graded for export during May and for the 10 months ended 31 May 1952 with comparative figures for the same month and 10-monthly period of 1950-51, have been compiled by the Dairy Division of the Department of Agriculture from figures supplied by divisional officers at the various grading ports:—

BUTTER

Period		Tons		% inc. or dec.	Total tons in store at end of mth.
	Creamery	Whey	Total		
May 1952 ..	3,248	107	3,355	—	18,112
May 1951 ..	3,845	153	3,998	—	30,492
Inc. or dec. ..	—597	—46	—643	—16.083	—12,380
For 10 mths. to 31/5/52 ..	154,468	2,636	157,104	—	—
For 10 mths. to 31/5/51 ..	148,566	3,004	151,570	—	—
Inc. or dec. ..	+5,902	—368	+5,534	+3.651	—

CHEESE

Period		Tons		% inc. or dec.	Total tons in store at end of mth.
	White	Coloured	Total		
May 1952 ..	4,370	3	4,373	—	18,104
May 1951 ..	6,842	—	6,842	—	27,396
Inc. or dec. ..	—2,472	+3	—2,469	—36.085	—9,292
For 10 mths. to 31/5/52 ..	89,181	751	89,932	—	—
For 10 mths. to 31/5/51 ..	101,009	1,526	102,535	—	—
Inc. or dec. ..	—11,828	—775	—12,603	—12.291	—

If these figures are converted into butterfat equivalent, there is a decrease of 0.013 per cent. in butterfat graded for the 10 months as compared with the corresponding period of the preceding season. It should be noted that the above figures refer only to butter and cheese graded for export, and that owing to diversions which may take place from time to time, they are not necessarily a true indication of production trends.

Early-potato Production: Kales for Winter Feeding

Seasonal Notes by the Extension Division

THE ACREAGE of main-crop potatoes to be dug in New Zealand during 1952 is the smallest so far this century. For that reason this year's early-potato crop assumes particular significance. Even though the main-crop yield may be above normal, there is a distinct probability that supplies will be exhausted earlier than usual. Consequently an earlier and a greater call on the early crop can be expected next spring, and interest in that crop is likely to be wider than usual.

CLIMATE AND SITE

Personal knowledge of the district is of paramount importance to a farmer who sets out to grow early potatoes, as such factors as time of planting are governed entirely by the frost risk and the climate of the locality. Even in districts where planting time is not limited by the frost risk, it is frequently possible to select an area for the earliest planting which, because of its aspect and shelter, will produce an earlier and better crop than other areas nearby.

POTATOES FOR SEED

One of the major problems of the potato grower is to ensure a satisfactory seed supply. Saving seed from one early crop to plant the next one is usually unwise, but seed harvested from later crops in the main growing areas frequently is not available in time for the earliest plantings. Different districts have adopted different methods to overcome this problem. In Pukekohe, for instance, a special autumn crop is grown from which immature tubers are taken to make early plantings in May and June. In some South Island districts early-potato growers also grow an "intermediate" crop and dig it early to provide seed for the early planting the following season.

Whatever the seed supply, it should be on hand well before planting time and be spread out to green under light, airy conditions but protected from the weather. Sprouting of the tubers before planting gives its best dividend in the earliest plantings. Machine planting may cause the sprouts to be injured or broken off, and hand planting of well-sprouted seed may be preferable to avoid this damage.

POTATO VARIETIES

The variety preferred for early planting differs very markedly from district to district and to a smaller extent among growers in a district. What might appear strange is that most commercial early-potato growers do not favour the first early varieties, but pin their faith to varieties of later maturity.

The Pukekohe growers prefer such varieties as Arran Chief and Northern Star, which are truly main crop in their period to maturity, to supply the bulk of the earliest marketed tubers. In other parts of the North Island Arran Banner, an early main-crop variety which begins formation of tubers early in its growth period, is first in importance. Aucklander Short Top, a variety of similar maturity, is also grown as an early potato.

In Canterbury a few growers still favour Epicure, a true early variety, but greater preference is shown for Arran Banner and also for Arran Pilot, which is intermediate in maturity between the other two. Jersey Bennes is the popular variety for early growing in the south, being nearest of those mentioned to Epicure in its period to maturity.

RISKS ENTAILED IN EARLY PRODUCTION

Early-potato growing entails considerable elements of risk. Frost, even in so-called frost-free areas, is a hazard. Some protection in the early stages can be given by keeping the young plants well moulded. In some districts late blight is always likely to attack the crop, and there only frequent and regular spraying or dusting will give protection against loss by this disease. Some damage is caused from time to time by potato moth, which is more prevalent in warm, dry districts, but the loss can usually be minimised by ensuring that in areas subject to the pest crops are dug early enough to escape the heaviest attack.

Finally, early potatoes are much more perishable than potatoes which are mature when dug. Careful handling of the crop is necessary to reduce damage to a minimum, and any short period of storage which might be necessary should be in cool, well-ventilated conditions.

—J. H. CLARIDGE

* * *

KALES FOR WINTER FEED

THE KALE CROP (including chou moellier) can be grown successfully in a wide range of soil and climatic conditions, but does best in districts where the summer rainfall is not unduly low. Kales supply a large bulk of succulent food in winter and have a long period of utility during which they deteriorate little, if any, in quality. Land preparation should follow similar lines to that required for swedes, and time of sowing extends from early spring to midsummer, depending on the purpose for which the crop is required.

TYPES OF KALE

Supplies of seed in sealed containers marked "Certified" for chou moellier and "Approved" for thousand-headed kale are available from retail seed houses. Two types of marrow-stemmed kales are available—the Giant and Medium-stemmed type of chou moellier. The Giant type, a New Zealand selection, is suitable for fertile land and for cattle feeding. It is tall growing with a heavy, fleshy stem specially suitable for cutting and feeding out to cattle. The Medium-stemmed type is another New Zealand selection developed for growing on the lighter types of land. It is not as tall or heavy in the stem as the Giant type and is more suitable for grazing.

Thousand-headed kale is a much older variety than the marrow-stemmed types and derives its name from the mass of branched foliage it carries. The stem is not fleshy as in the marrow-stemmed types, and the plant is adaptable to a wide range of conditions and usages, being particularly suitable for sheep feeding and for growing in drier districts.

TIME OF SOWING

The marrow-stemmed kales popular on the heavier lands for cattle feeding are usually sown in early spring, generally on ridges. For general sheep-feeding purposes the time can well be extended to early summer.

The thousand-headed type is also suitable for early and late sowing. When sown early, especially in the wetter districts, it can be grazed in summer or autumn and, if it is not punished too hard, a substantial amount of grazing can be obtained from the second growth.

It is not uncommon, particularly in the drier districts, when sowing swedes to distribute an ounce or two of kale seed with the manure from the rear box. The scattered kale plants provide what is generally considered to be beneficial shade for the swedes.

—J. O. WALLACE

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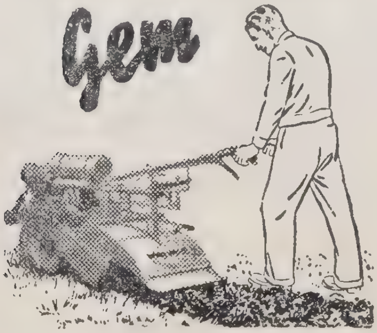

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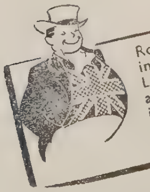

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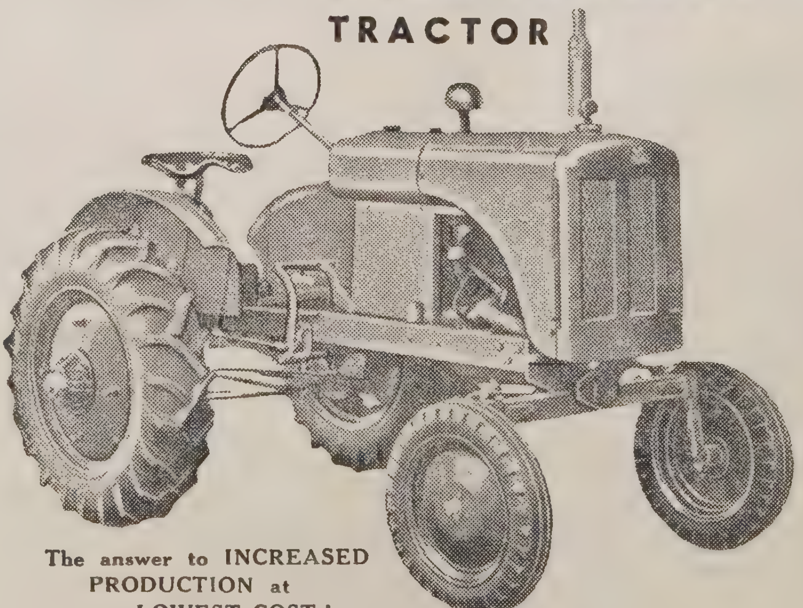

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Range Shelters for Poultry

By W. L. JOURDAIN, Manager, Poultry Demonstration Plant, Department of Agriculture, Upper Hutt

OF all the causes of young growing poultry failing to come up to the standard expected, overcrowding is the most common and most easily rectified. Overcrowding occurs not only in the houses in which stock is reared but also on the range or in pens attached to the houses. Range shelters are planned to give stock a roof during bad weather, and are so made as to give ample ventilation.

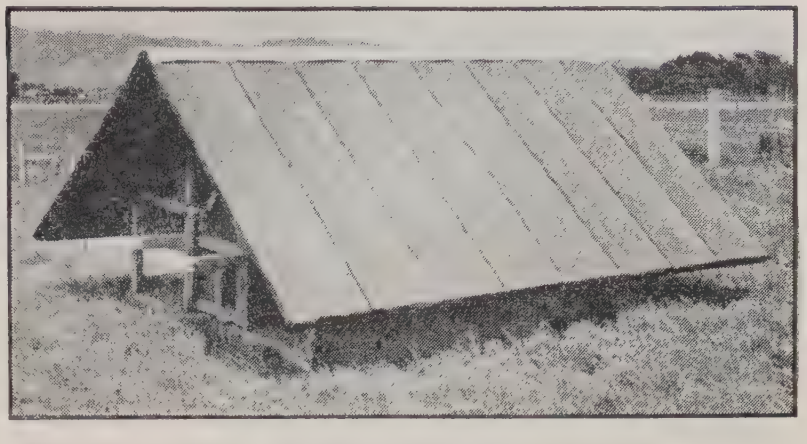


Fig. 2—Tarred sacks are the roofing material used in this range shelter.

ON the Poultry Demonstration Plant the range shelter described has proved very successful for stock from 6 weeks old to maturity. The weather in winter and spring in the Hutt Valley is probably as cold as in most other places in New Zealand, but stock in the shelters do exceptionally well when precautions described later are taken.

The illustrations show the general construction of the range shelters, and from Figs. 1, 3, 4, and 5 it should be easy for a handyman to construct such a shelter.

The 3in. by 2in. studs were a nuisance in the position in which they are to be seen in Fig. 1, and have been placed outside the bottom 12in. by 1in. board. This makes the installation of the wire floor very much easier and if the floor has to be replaced, the advantage will be doubly appreciated. The bottom board in Fig. 1 is only 6in. by 1in., but this is not wide enough and therefore the size has been increased to 12in. by 1in. in Fig. 5. The perches in Fig. 1 were 2in. by 2in., but these have been substituted by 4in. by 2in. perches placed on their wide side, giving the birds 4in. to rest on when perching. As a result there is a decided reduction in the number of bent breasts encountered.

The wire floor is both a valuable disease-control measure and a labour saver, because there is no accumulation of droppings to endanger the health of the birds. The floor boards supporting this wire, as in Figs. 3 and 4, should be bevelled to ¼in. to allow droppings to fall through more easily. It has been found that 1½in. square mesh netting, 12 gauge wire, is best for this type of floor. Not only will it outlast ordinary wire netting but also it can be made to fit very much more firmly. The wire mesh is first stapled to the under side of the 2ft. boards and then stapled round the outside of the house. The 2ft. boards can then be drawn together, with builders' cramps, and nailed in position, thus making the wire floor taut, as is shown in Fig. 3. The wire mesh used for the floor has also been used for the walls of most of the shelters at the Upper Hutt plant; it can be purchased in any width required and in a variety of sizes of mesh.

The height of the range shelters is 5ft. 8in. to the apex and the walls are 3ft. high. The floor is 7ft. wide by 8ft. 6in. long.

Roofing

Four different styles of roof have been tried.

A type of fairly thick building paper was found to be of no use. On one house it was left in the original state

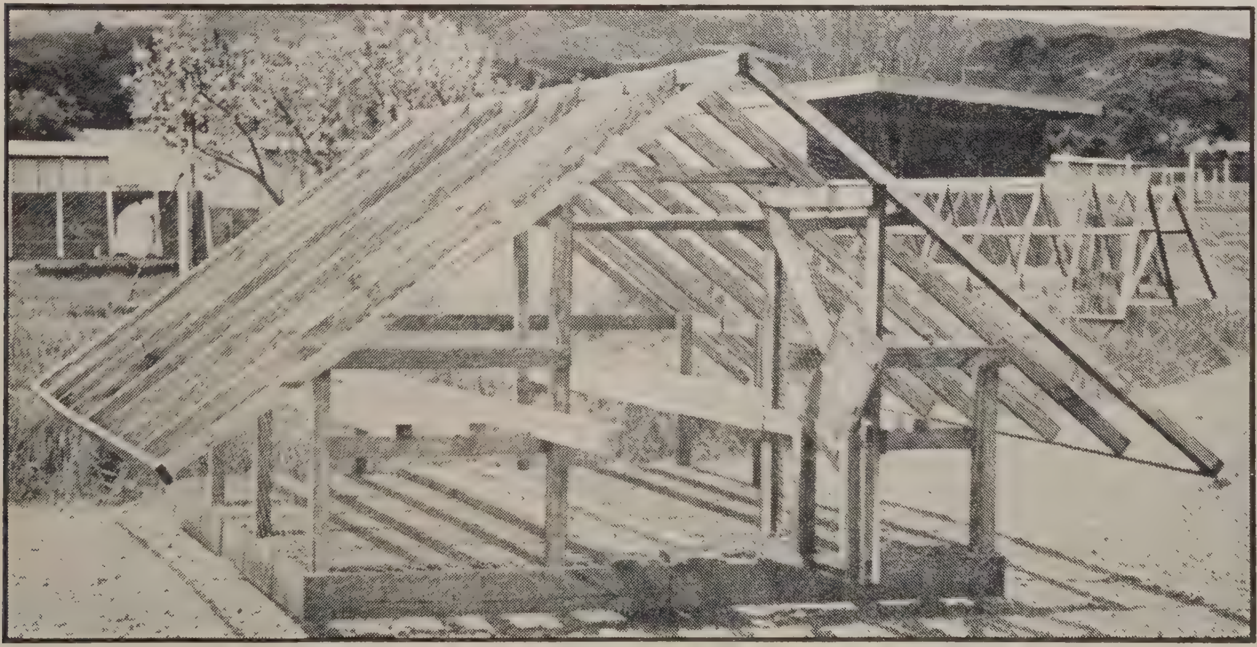


Fig. 1—Construction of a range shelter, for which improvements are given in the text and in the plans on the next page.

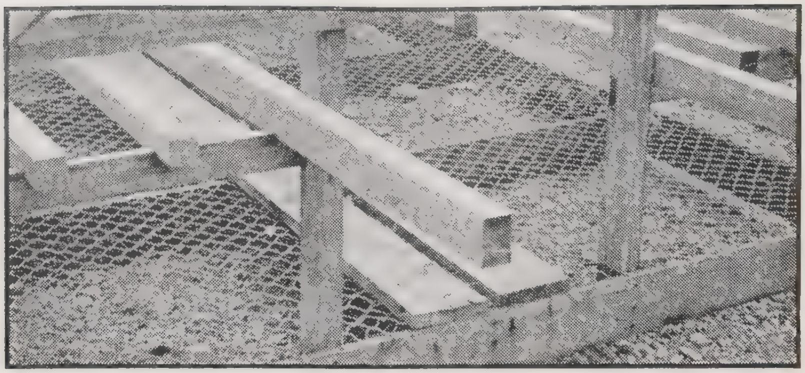


Fig. 3—The wire floor shown is a valuable disease-control measure and a labour saver, because there is no accumulation of droppings.

and on the other house it was painted, but in both cases it rotted through very quickly.

Tarred roofing material over wooden sarking proved very good, the only drawback to this type of roof being the weight. The houses with this type of roof were very much too heavy even for four men to shift, due to the wooden sarking.

Tarred roofing material over wire netting was also very good, and provided the wire netting was stretched tightly and there were adequate battens, this type of roof was perfectly satisfactory. This type should be as good as the previous method.

Equally as good as the previous two methods should be the use of tarred sacks (Fig. 2), provided the wire netting which is placed over the rafters under the sacks is stretched tightly. The sacks were cut down the seams, stretched as tightly as possible over the rafters, and painted with hot tar to which had been added as much carbonate of lime as it would hold. If these roofs are tarred each year for the first 3 years, they should last for some years with no further treatment.

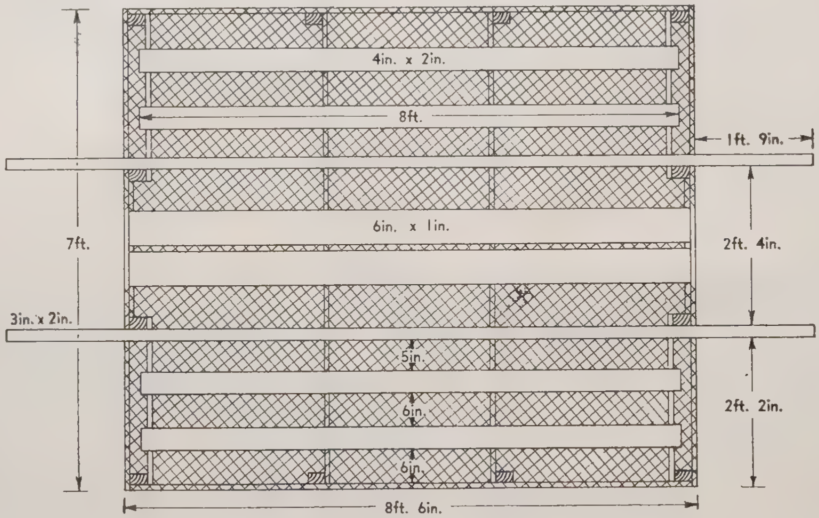


Fig. 4—Plan of range shelter.

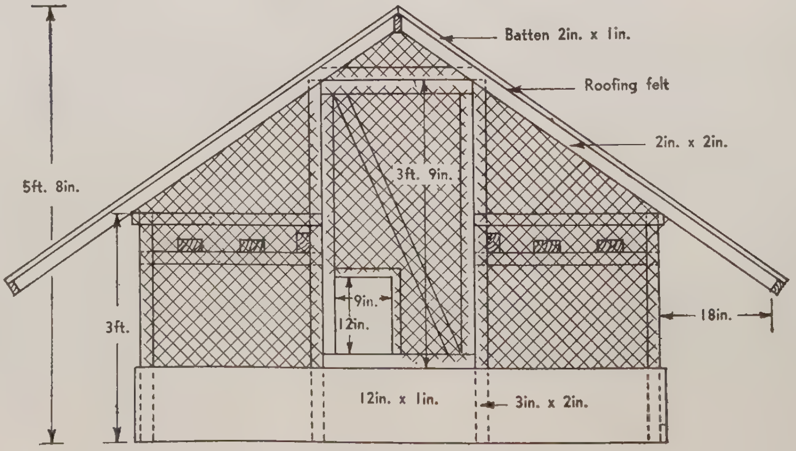


Fig. 5—Front elevation of shelter.

Instructions

During cold, windy winter weather, it is advisable to place boards or sacks along the side facing the prevailing weather and also at one end of the shelter. This will prove of particular benefit to stock before they start to roost. It is highly desirable to remove this sacking when all the birds have learnt to perch. Stock reared in these shelters will always perch themselves, thus saving the farmer a lot of time and trouble.

If the shelters need shifting any distance, or very often, the job will be made much easier if skids are placed under the sides.

A shelter of the dimensions given, with 6 perches, is suitable for approximately 120 cockerels or pullets at 6 weeks of age, but this number must be reduced to 50 and 60 birds by the time the birds are 4 months old. Neglect to thin out the birds up to this age will mean overcrowding and a consequent severe check in development.

The centre perches of 3in. by 2in. timber are carried through the ends, providing handles for moving the shelters when cleaning out underneath them. The other 4 perches are 4in. by 2in. placed to give the birds 4in. on which to perch.

Location

The shelters are placed on range with the side of the roof facing the prevailing weather. It is a big advantage if these shelters can be used on range where there are trees or hedges to give some protection from the inclement weather. This type of range shelter is not suitable for moving every 1 or 2 days. When it is moved to be cleaned out it should be put back in the same place to prevent the stock scratching where the droppings have been. If it is desired, they can be moved to a new position for the following season provided the previous situation is cleaned and well limed.

Tail picking or any other cannibalistic habit is never seen if young stock are reared in this type of shelter. With plenty of fresh air and therefore an absence of overheating, conditions are ideal for the stock to make good growth.

When the birds are let out first the food and water are naturally placed handy to the shelter, but they should be moved well away once the birds are used to their new quarters. The troughs and water tins should be moved frequently to avoid bare patches which would otherwise appear.

Although rearing of poultry under these conditions is ideal, the poultry farmer needs to be always on the alert for any wrong condition which may develop. It is still possible for parasites such as lice and red mite to make their appearance. They should be dealt with immediately so that there is no check in the growth and development of the stock.

Pruning . . . Planting . . . Draining . . . Spraying

WINTER WORK IN HOME ORCHARDS

MOST important of winter work in the home orchard is usually pruning, but as well as general work other tasks which may require attention at this time of year are planting of fruit trees, drainage, provision of shelter, and application of winter sprays. Advice on those subjects is given in this article by the Horticulture Division.

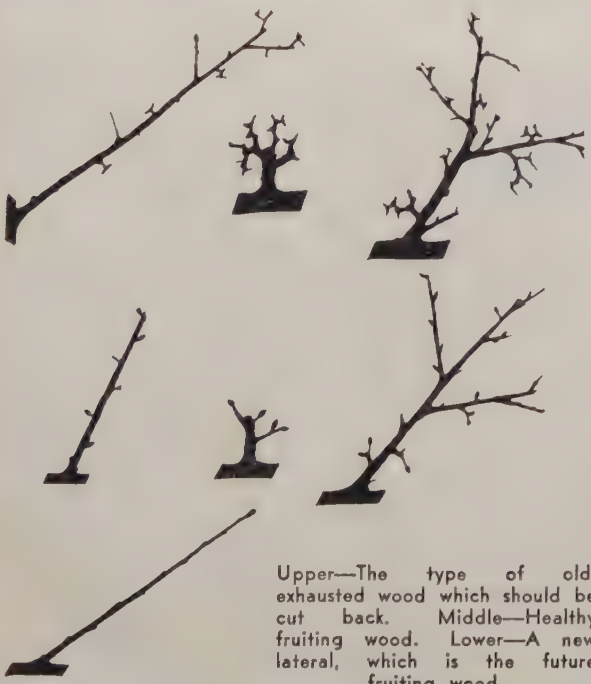
ADVANTAGE should be taken of fine weekends early in winter to accomplish outside work in the orchard. Delaying it until well into winter entails the risk of not being able to get the work completed at the right time if wet weather sets in.

Pruning

As soon as the leaves have fallen pruning should be started, and because of their earlier bud movement in spring stone fruits and bush fruits should be pruned before pip fruits.

For the first 5 or 6 years after a young tree has been planted the purpose of pruning should be to encourage production of a sturdy framework, and during those early years fruiting should be allowed only to an extent that does not interfere with necessary growth. A common mistake in training a young tree is to have too many leaders and too great a spread of the tree, with the result that the leaders tend to be weak and spindly and are unable to stand up under the weight of crops in later years.

As the tree becomes older it becomes well furnished with laterals, twigs, and spurs; while these are young and vigorous they carry excellent fruit, but as they age and weaken they become poor conductors of plant food, and fruit carried on them is likely to be small and of poor quality. The system of pruning recommended envisages the continual removal of fruiting wood as it becomes old and exhausted and the refurnishing of the tree with young, healthy laterals and twigs.



Upper—The type of old, exhausted wood which should be cut back. Middle—Healthy fruiting wood. Lower—A new lateral, which is the future fruiting wood.

[*Sparrow Industrial Pictures Ltd. photo.*

Pip Fruits

Apple and pear trees fruit on laterals and spurs of 2 years old and more. Laterals are preferable to spurs, as they are better conductors of plant food, remain vigorous for longer, and are more easily renewed by being cut back when they have become aged and weak. In the pruning of the bearing tree the fruiting parts may be treated as follows each winter:—

The greater part of the old and exhausted laterals and spurs should be cut back to promote new growth.

The present healthy fruiting wood should be shortened where necessary to prevent overcrowding.

The future fruiting wood, consisting of new laterals or spurs, should be thinned to prevent overcrowding.

Cutting or shortening of all annual wood growths is likely to cause excessive growth and removes much valuable early leafage which is required to assist fruit setting. Greater and earlier fruit bud formation is encouraged by leaving the new lateral growths uncut for the first year.

In brief, the lateral shoot is grown, encouraged to fruit early, and after a fruiting life of 4 or 5 years is cut back and renewed; the cycle then is begun again.

Old trees which have stagnated and are devoid of new lateral growth may be rejuvenated by the cutting back of from 30 to 40 per cent. of the exhausted spurs and laterals for the first winter treatment. The remainder of the old fruiting wood should be cut back and renewed during the following 3 or 4 years and the normal cycle of refurnishing over 5 or 6 years then followed.

Should a tree be too vigorous, less new growth should be thinned out; conversely, as a tree stagnates, more cutting back of old wood and thinning are necessary to promote new growth.

Stone Fruits

Peach and nectarine trees fruit only on lateral growth made the previous season, and the correct treatment of bearing trees consists of the removal of the 2-year-old laterals and thinning of the 1-year-old laterals sufficiently to prevent overcrowding. These trees require heavy annual pruning and usually it is necessary to remove more than half of the lateral growth at each winter pruning. Failure to cut away sufficient lateral growth results in the lower parts of the tree becoming devoid of fruiting wood. The leaders should be shortened sufficiently to cause new growth to break out lower and keep the tree furnished with healthy new laterals.

Plum, apricot, and cherry trees fruit mainly on spurs of 2 years old and more. Robust fruiting laterals are preferable to spurs, which soon become weakly and carry poor-quality fruit. Each winter 25 to 30 per cent. of the older spurs and laterals should be cut back.

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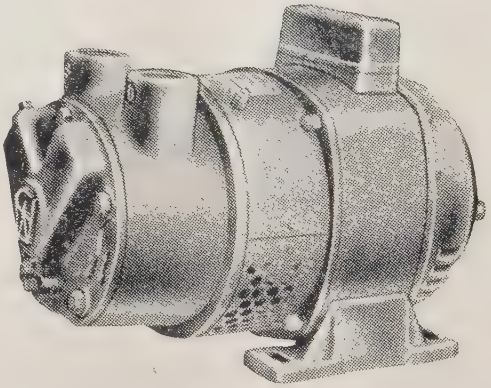

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Citrus Fruits

Though citrus trees seldom need pruning as heavily as do pip and stone fruits, a moderate pruning should be carried out each year. Pruning of fruiting trees consists mainly of thinning out crossing laterals and removing all dead and diseased wood and heavy upright watershoots.

Most lemon trees are pruned in spring when danger of frosts is past, but pruning of orange trees is usually delayed until after the fruit has been harvested.

Small Fruits

Raspberry bushes fruit on canes produced the previous season. Pruning consists of the removal at ground level of all canes which have cropped during the season and of any of the new season's canes which are weakly or diseased.

Gooseberry bushes fruit on 1-year-old shoots and on spurs on older branches. They need to be kept fairly open, and sufficient old wood should be cut back each winter to promote the necessary amount of new growth in spring.

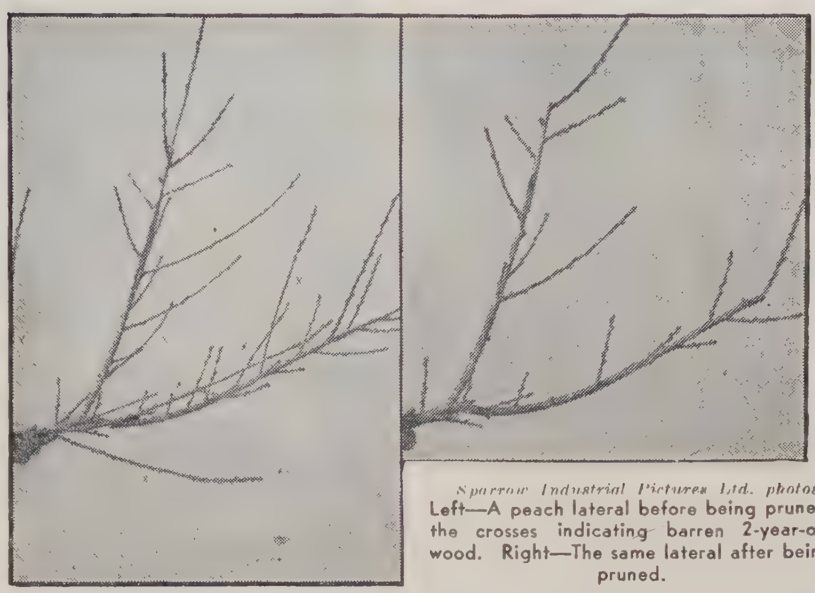
Black currant bushes produce the majority of their most luscious fruits on growth made the previous season. Pruning consists of removing branches which have fruited, leaving strong young wood for fruit production. The old wood should be cut back to strong, healthy, young shoots, the nearer the ground the better.

Red currant bushes fruit similarly to gooseberries, and the fruiting laterals and spurs should be renewed every 4 or 5 years as the fruiting wood begins to become sparse on any piece of older wood. The bush should be kept sufficiently vigorous to develop at least four or five new vigorous shoots annually.

Treatment of Wounds

Tree wounds, whether caused accidentally or through the removal at pruning time of fairly large branches, must receive proper attention to prevent bacteria or the spores of fungi gaining entrance.

After trees have been pruned all cuts larger than ½in. in diameter should have the edges trimmed carefully with a sharp knife and a sealing compound applied over the cut.



Sparrow Industrial Pictures Ltd. photos.

Left—A peach lateral before being pruned, the crosses indicating barren 2-year-old wood. Right—The same lateral after being pruned.

Planting

Fruit trees and bushes received from the nursery should be unpacked and heeled in without delay in a shady position to await being planted in their permanent positions.

If possible, holes for the trees should be dug some time before the trees are to be planted. The topsoil should be removed carefully, a second spit taken out, and the topsoil put in its place. Up to 1lb. of blood and bone manure may be forked lightly into the soil at the bottom of each hole before the tree is planted.

The trees will require attention to their roots before being planted. When they are received from the nursery their roots are usually torn and broken, and if they are planted in this condition, the roots tend to decay and die back. The heavier roots should be cut back to 3 or 4in. and the lighter and fibrous roots cut away.

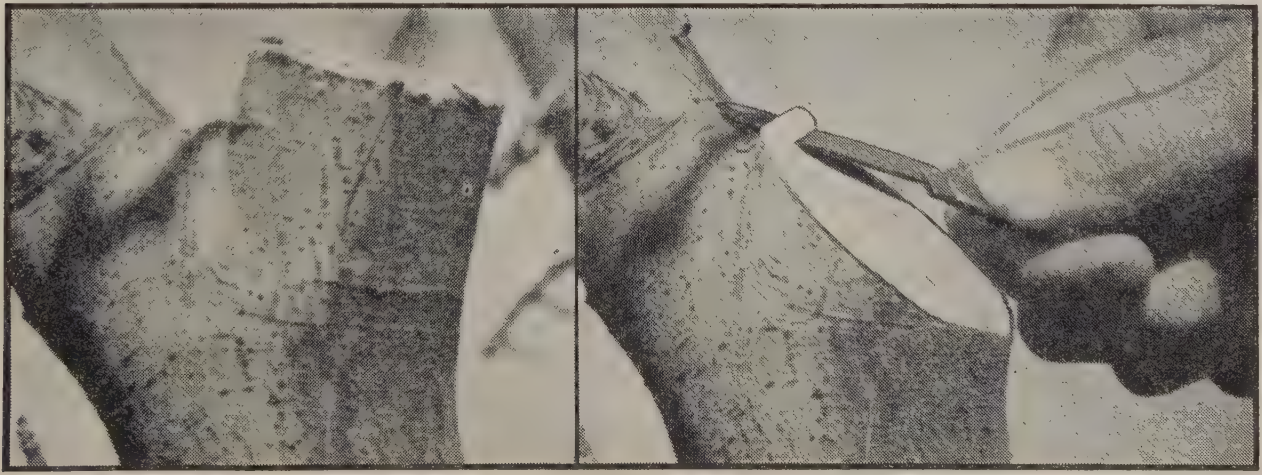
Citrus trees should be set at the nursery depth and all other trees about 3in. deeper than they were in the nursery. The soil mark on the trunk will indicate the depth at which the tree was planted in the nursery.

The essential factor in planting is to fix the tree firmly by treading the soil around the roots. Only the final layer should be placed loosely around the tree, with the level slightly above the usual soil level to allow for settling.

Drainage

Though different kinds of fruit trees will stand varying amounts of soil moisture, the surplus must be removed. Excess of water in the soil is primarily responsible for many of the troubles and diseases in home orchards.

Rapid dispersal of the winter rainwater is necessary, and if the soil is heavy and tends to remain waterlogged, early attention should be given to drainage.



[*Sparrow Industrial Pictures Ltd. photos.*

Left—This cut was made too far from the main branch, leaving an ugly stub which will not heal over readily. Right—The cut as it should have been made—close to the main branch and with the edges trimmed with a sharp knife.

Usually open drains along the boundaries of a home orchard are sufficient, but if they do not prove adequate, it may be advisable to lay one or two lines of tile drains diagonally across the slope of the orchard. This should be done as early in winter as possible.

Shelter

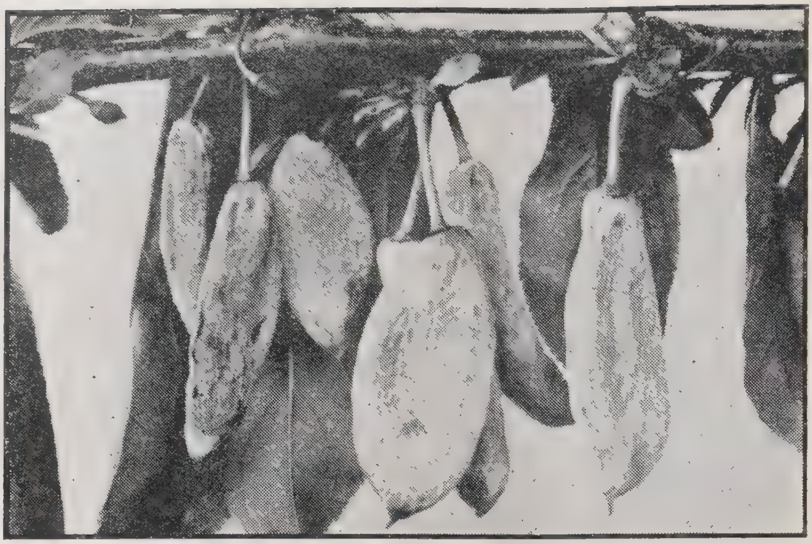
The orchard should be sheltered from both prevailing and cold winds. Inadequate protection results in a retarding of the normal growth and development of the trees and a reduction of their cropping ability. However, excessive shelter tends to promote conditions favourable to pests and diseases. Shelter should not prevent the trees receiving the full benefits of sunshine, for sunlight is necessary in the promotion of the full colour and flavour of fruits and in the maturing of the new season's growth.

Trees and shrubs for permanent shelter can be planted in winter. An idea of the kinds suitable for a locality can usually be obtained by studying trees and shrubs already growing there. Trees that will become too high for the needs of the site should not be planted.

Winter Sprays

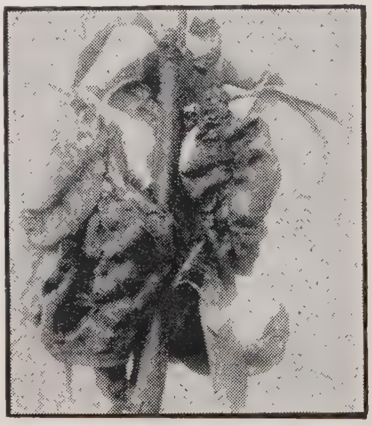
Winter oil should be applied to all deciduous fruit trees and to berry fruits other than strawberries while they are dormant at a strength of 1½ pints to 4 gallons of water for the control of scale insects, woolly aphides, and red mite eggs. Stone fruits and berry fruits should be sprayed before the end of July; for pip fruits the application may be delayed until toward the end of August.

To mix winter oil pour the required quantity into a clean container and add an equal amount of water slowly while stirring vigorously. If the water is hard, add a small amount of washing soda. Continue stirring until an emulsion has been formed and no free oil is present. Add the emulsion to the water in the spray container.

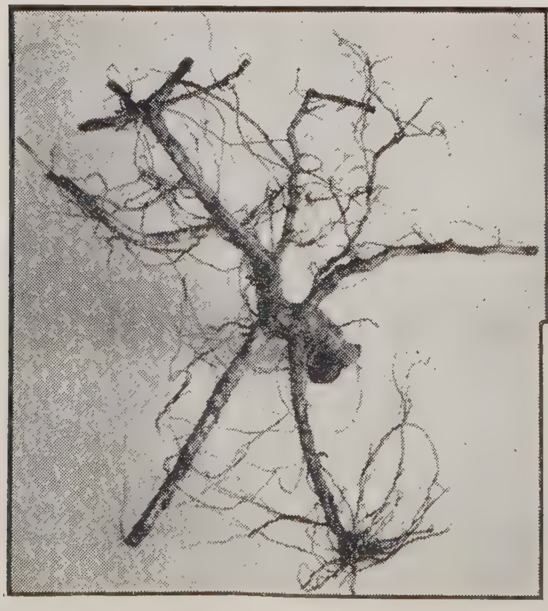


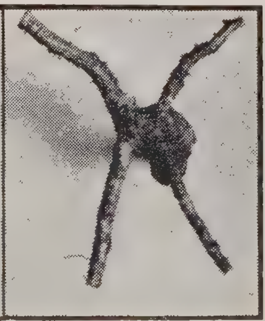
[*W. D. Reid photo.*

Distorted, spongy fruits caused by bladder-plum disease on a Japanese plum tree.



A peach shoot infected with leaf curl.





[*Sparrow Industrial Pictures Ltd. photos.*

Left—The roots of a young peach tree as it was received from the nursery. Above—The roots trimmed and ready for planting.

An application of Bordeaux mixture (6½oz. of bluestone and 5oz. of hydrated lime to 4 gallons of water) should be made to all deciduous fruit trees and to all berry fruits except strawberries as the buds begin to move in spring. This spray is important in the control of a number of fungous diseases, particularly leaf curl of peaches and nectarines, bladder plum of plums, black spot of apples, and cane wilt and leaf spot of berry fruits.

Another but weaker spray of Bordeaux mixture (4oz. of bluestone and 5oz. of hydrated lime to 4 gallons of water) should be applied to stone fruit trees 10 to 14 days after the first Bordeaux spray and to berry fruits early in September.

To prepare Bordeaux mixture dissolve the required amount of powdered bluestone in 2 pints of warm to hot water in an earthenware or wooden vessel. Mix the hydrated lime to a thin paste with 2 pints of water, add it to 3½ gallons of water in the spray container, and stir. Then add the bluestone solution, mix them all thoroughly, and apply the spray as soon as possible. Containers for Bordeaux mixture should be of copper, brass, wood, or earthenware, as bluestone rapidly corrodes iron. If a kerosene tin must be used, its useful life will be prolonged if it is wiped over thoroughly with a heavy oil before it is filled with spray.

General Work

As soon as pruning has been completed the prunings should be picked up and burnt. If wood is required for grafting later, it should be selected at pruning time and heeled in a shady position until required.

It is advisable to dig over the ground around the trees in winter and so bury fallen leaves and rotting fruits. Digging should not be to a depth which will damage the roots.

Fertilisers containing phosphate and potash may be spread before the digging so that they will be turned well under. Fertilisers containing nitrogen can be topdressed around the trees about the time of bud movement and hoed in lightly.

Aims and Advantages of the Young Farmers' Club Movement

CONSISTING of 333 clubs with a total membership of nearly 10,000, the New Zealand Federation of Young Farmers' Clubs seeks to make its members capable of taking an active part in public affairs, to make them better farmers, and to make country life more attractive to the young man on the land. Though by no means exhaustive, the following survey of the activities and aims of the Y.F.C. organisation, prepared by members of the Wairoa Club (Northern Hawkes Bay), is intended to make more widely known the value and advantages of Y.F.C. membership. Some areas in New Zealand are still without clubs, and farmers in such places could with advantage influence their sons and younger workers to form clubs.

Shearing competitions have resulted in a rapid improvement in the standard of shearing among Y.F.C. members.

TO join a Young Farmers' Club a man need not be a farmer; if he is interested and prepared to attend meetings of his club regularly, he will be made welcome. In many clubs the membership includes stock agents, school teachers, clerks in mercantile firms, country store assistants, and occasionally public servants. Many such members may be unable to take part in activities such as shearing and ploughing, but they may play a leading part in debating and sporting activities and in the administration of club affairs.

Aims and Activities

To encourage young men to take part in public affairs, regular club meetings are conducted on formal lines and adherence to approved procedure is encouraged. Members thus learn to give their views to an audience plainly and without embarrassment.

In the winter debating occupies much time at club evenings. Club, inter-club, inter-district, and inter-council debates are held and members of club teams reaching the finals in inter-council debates gain knowledge and experience in debating that otherwise would take years to acquire.

International Flavour

At least two Y.F.C. activities have something of an international flavour. The more far reaching is the exchange of members with the United States of America. As part of the International Farm Youth Exchange scheme (I.F.Y.E.), sponsored in New Zealand by the New Zealand Dairy Board, four members go to America each year to study farming and rural conditions there, and American members visit New Zealand. Each club may nominate a member, and the four who travel are selected through a series of elimination contests.

Machinery demonstrations at Y.F.C. field days such as this quite commonly attract attendances numbered in thousands, thus enabling clubs and members to perform a valuable community service as well as to gain experience in leadership and organisation.

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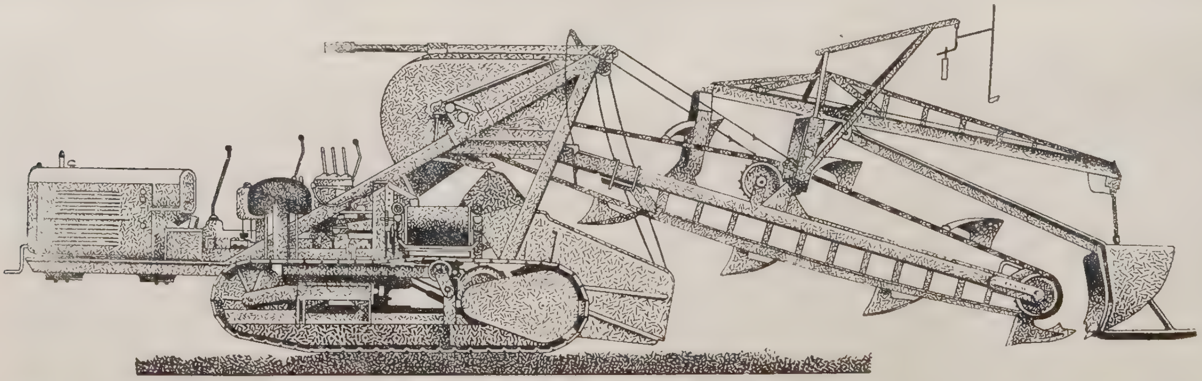

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The radio leadership contest for members under 21 years of age, originated by the Australian Broadcasting Commission, provides excellent publicity for the Y.F.C. organisations throughout Australia and New Zealand as well as helping to develop qualities of leadership in competitors. Each club may put forward a candidate, and the series of contests culminates in the selection of the grand finalist. New Zealand has gained two seconds and one first in the grand final at Sydney in the past 3 years.

This year, for the first time, the grand final was held in New Zealand, being won by John Wedemeyer, of Queensland.

Development of Ability

Contests such as debating and radio leadership, and activities ranging from club meetings to international reciprocal exchanges, develop in future farmers the ability to take their places in any meetings and there express their views clearly and concisely. Already men who have received initial training in public speaking in the clubs have taken their places on local bodies, farmer organisations, and other public or semi-public groups and are serving their communities with distinction.

Y.F.C. meetings and other activities are kept free from anything of a party-political or sectarian nature.

Scope of Club Work

About two of every three club meetings are attended by competent lecturers, who discuss a wide variety of subjects. Veterinary surgeons, stock inspectors, Departmental instructors, bankers, breeders, and many others give the value of their experience in their own fields. Film evenings frequently are attended by parents and friends as well as members.

Clubs and district committees organise field days and demonstrations whenever possible. These activities are often hampered by the fact that many members are engaged in seasonal work that does not permit time away from the farm, but most employers are considerate and facilitate members' attendance at educational field days. On these occasions members watch demonstrations and receive instruction in a wide variety of subjects, including machinery maintenance, pruning of fruit trees, beekeeping, diagnosis of stock diseases, wool classing, and pasture species recognition.

As a result of Y.F.C. shearing competitions in Northern Hawkes Bay, as elsewhere, the standard of shearing among members, many of whom once could not shear, is improving rapidly. Indeed, many members now find the shearing season very lucrative.

Judging of stock on a competitive basis encourages young farmers to study this important aspect of farming. After the competition is over competent judges usually explain to contestants the points of the animals before them and reasons for their placings. Shearing and stock-judging competitions, and in some areas ploughing matches, dog trials, and the like, are held not only between clubs but often on an inter-district and inter-council basis as well.

Judging of stock on a competitive basis develops skill in this important aspect of farming, and such competitions are held not only between clubs but often on an inter-district and inter-council basis as well.

Machinery displays are held frequently in many districts. Recently a Mid-Canterbury club with a membership of only 20 organised a demonstration with 80 displays, and about 2000 people attended. Such attendances, and larger, are usual at many of these field days. These displays keep not only young farmers but members of the older section of the farming community in touch with modern developments in farming machinery. They provide members with excellent training in leadership and organisation, and at the same time give a service to the community and publicity to the movement.

Field days may also take the form of visits to farms, research stations, butter and cheese factories, canneries, and other places where the young farmer can see what happens to the produce that leaves his farm.

The Y.F.C. movement encourages scientific training in agriculture by means of scholarships tenable at Massey and Canterbury Agricultural Colleges. In addition, it co-operates with the colleges in the selection of a variety of short courses for young farmers during winter.

Members frequently act as assistant stewards at A. and P. shows and support many other community activities. Service to boys' and girls' agricultural clubs, on producer organisations, and on local community affairs such as sports and carnival associations is commonly given by Y.F.C. members.

Social Life and Sport

In recent years many public speakers have lamented the difficulty of attracting young men to the country. One of the reasons is the lack of social activity in the country compared with the attractions of the town. The Y.F.C. movement contributes largely toward overcoming this lack. The monthly meetings themselves provide a good opportunity for a newcomer to meet men of his own age and to form friendships. Most clubs hold dances and many districts hold annual balls.

Sporting activities provide another means of adding to the attractions of country life. In the Northern Hawkes Bay district the annual sporting fixtures organised by the Y.F.C. include athletics, swimming, tennis, and shooting, all with trophies for inter-club competition. Inter-club football and cricket matches are played, and many of these activities carry the winners further afield to inter-district events.

Tours of Other Districts

Other opportunities of broadening their outlook are provided young farmers by conducted and billeted tours of other districts. Recently the Northern Hawkes Bay District Committee arranged two conducted tours. One to the Bay of Plenty, Waikato, and Rotorua, lasting a fortnight, included visits to paper mills, farms, and research stations and proved so successful that it was followed by a tour of the Manawatu, Taranaki, and the King Country.

Last year an exchange of billeted visits was arranged with the Western Southland District Committee. On this tour members stayed on farms and often helped with the seasonal farm work. These holidays provided by the Y.F.C. organisation not only prove entertaining, but also give members an insight into farming methods in other districts.

New Members and New Clubs

Young men who do not personally know a Y.F.C. member may obtain full information from local offices of the Department of Agriculture. In areas where the movement does not yet exist older farmers interested in securing for their sons and young workers the benefits offered could well take the initiative in sponsoring new clubs; they will find Departmental instructors, who act as district Y.F.C. secretaries, ready to assist.

The value of the movement is cumulative as well as immediate in its effect. Young men whose ambition is to achieve leadership in any rural field, farming or civic, will find that Y.F.C. membership will help them to develop qualities of initiative and farming ability.

HEADING PHOTOGRAPH: Development of red tussock grassland.

Developing Ploughable Tussock Grassland in Southland

SOME of the most striking increases in sheep-carrying capacity in recent years have been made in Southland through the development of ploughable tussock grassland. Though some of the country had been partially developed many years ago, much of it had reverted to pastures of low carrying capacity. Good seed, fertilisers and lime, and drainage have all contributed to the success of the type of development described in this article by S. H. Saxby, Agrostologist, Department of Agriculture, Wellington, and W. Faithful, Fields Instructor, Department of Agriculture, Invercargill.

WHEN settlement first began in Southland much of the land was an almost unbroken treeless expanse covered with a tall reddish-brown tussock grass, red tussock (*Danthonia raouli*), which grew 3 to 4ft. or more high and completely overshadowed many other smaller plants.

In the low-lying, swampy areas flax (*Phormium tenax*) was abundant and toetoe (*Arundo conspicua*) was common. Bush occurred on some of the steeper hill country and also in patches throughout the tussock-covered area. Where the tussock fringed the bush areas manuka (*Leptospermum scoparium*) was plentiful.

Climate

In the area in which the red tussock was dominant the annual rainfall is about 45in. Though this is not particularly high, distribution is very even, rain falling on about 200 days a year. Winters are cold and wet with frequent frosts and occasional snowfalls. Drought or near-drought conditions are experienced in some summers, but are not frequent.

Soils

Most of the soils of the red tussock country overlie compact clay subsoils, are leached and poorly drained, and tend to lie wet in winter and to dry out in summer. Partly and fully developed peat soils are present in the numerous shallow valleys, many of which are boggy and contain sluggish streams.

History of Development

Red tussock grassland is of little or no value for grazing by sheep or cattle. It is eaten to a small extent by cattle, but provides bare maintenance. Consequently, since settlement began every endeavour has been made to replace it by high-producing pastures.

Early efforts at development were not very successful. The destruction of the tussock was relatively easy, but permanent pastures of high carrying capacity could not be established and maintained.

Cropping, particularly with oats and turnips, was practised very widely. Oats were required for horse feed and for export and turnips were necessary for the wintering of sheep. This cropping, particularly with oats, was also needed to assist in supplementing income from stock on the low-producing and short-lived pastures. Because only low-producing strains of ryegrass and white clover were available, it was necessary to renew pastures at frequent intervals to maintain carrying capacity. If pastures were not renewed frequently, they became dominated rapidly by browntop, which in the absence of vigorous clover produced a relatively small quantity of unpalatable feed. Such pastures also tended to encourage the ingress of plants such as gorse, manuka, and broom. For many years, therefore, farming on the red tussock country was based either on short-term, ryegrass-dominant pastures and a large amount of cropping or on browntop-dominant pastures with much less cropping. Under either system carrying capacities were comparatively low. The better farms carried about 1½ ewes per acre and devoted at least 10 per cent. of the total area to turnips for winter feed. Lambing percentages were low and comparatively few lambs were sold fat off their mothers.

Changes in Pasture Production

Although now good fattening pastures can be established and maintained, development and acceptance of the various factors involved have been slow. Of these factors five are of

STAGES IN DEVELOPMENT OF RED TUSSOCK GRASSLAND

During the last 20 years several thousand acres of ploughable tussock grassland in Southland of low carrying capacity has been converted to a state where it will support 3½ ewes per acre. Stages in development shown are: Upper left—Burning the tussock to destroy the top hamper. Upper right—Burnt tussock ready for ploughing. Middle right—A deep, wide furrow buries most of the tussock. Lower left—Low-lying areas have to be drained. Lower right—The first crop after ploughing is usually swedes or turnips.

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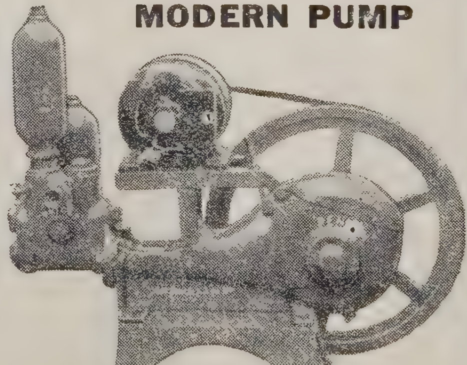


As red tussock is of little value for grazing, efforts have been made for many years to replace it with high-producing swards. During early development of the tussock land in Southland pastures had to be renewed frequently to maintain carrying capacity, because only low-producing strains of ryegrass and white clover were available. If pastures were not renewed frequently, they tended to become dominated by browntop and to be invaded by gorse, manuka, and broom. The availability of good strains of grasses and clovers has had a considerable influence on the success of later development. Above left—Undeveloped red tussock grassland. Above right—Sluggish stream bordered by red tussock and flax (*Phormium tenax*). In circle—Red tussock. At right—Typical red tussock grassland that has been developed and allowed to revert to browntop and weeds. The only satisfactory manner in which this country can be improved is by ploughing and sowing certified strains of grasses and clovers together with lime and phosphatic fertiliser.

major importance: The use of lime, the use of phosphatic fertilisers, the availability of permanent, high-producing strains of ryegrass and white clover, drainage of both rolling country and swampy areas, and the use of cobalt in some districts.

Improved management has resulted in very marked changes. Country that previously had been developed and had reverted to browntop now has been brought to a state of high production and considerable areas of virgin tussock land have been developed in recent years.

Current Practices

Though present-day practices vary in detail, all have the common objective of raising soil fertility to a state where it is possible to maintain good pastures based on high-producing permanent strains of perennial ryegrass and white clover.

The tussock is usually burnt in summer to destroy the top hamper of foliage which, if not destroyed, would interfere with cultivation and consolidation. The land is ploughed in autumn and winter with a swamp plough, a furrow about 8in. deep and 20in. wide being turned. The ploughing is followed by a period of fallow lasting at least 12 months, which allows the ground to consolidate, the butts of the tussock to decompose partly, and the soil to sweeten.

During the fallow the ground is usually disced once or twice to assist consolidation and destruction of the buried tussock butts. Discing is done along the furrows with little cut on the discs. In spring the land is worked down with further discing, harrowing, and rolling to provide a seed-bed.

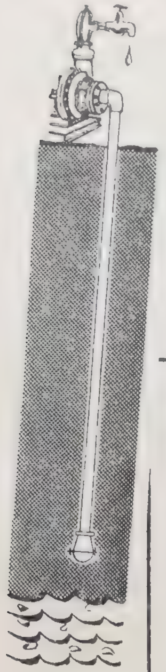
Because of the general need for winter feed, it is customary to ridge in a crop of swedes or turnips in November, using up to 14oz. of seed per acre. Phosphatic fertiliser, either in a proprietary mixture or reverted superphosphate, is sown with the root crop at the rate of 2 to 3cwt. per acre and, before sowing, 1 ton of carbonate of lime is applied. On newly brought-in land intercultivating of the root crop is not usually necessary, as weeds are not numerous.

Feeding off of the root crops is usually completed by September and preparation of the next crop is begun at once. As ploughing tends to bring the partly rotted tussock butts to the surface, the land is surface worked with the discs, harrows, and roller. It is limed at the rate of 1 ton per acre.

In Southland club root is often very troublesome in a second root crop and therefore the second crop is usually of resistant varieties of turnips or swedes, kale, chou moellier, or club root-resistant rape.

After the second crop is fed off the land is again limed at the rate of 1 ton per acre after light surface working with the discs, harrows, and roller in spring.

Sometimes oats are drilled in at the rate of 2 to 3 bushels per acre before a permanent pasture mixture is sown on a rolled surface. The oat crop is harvested for grain, though in the past large areas were cut for chaff.



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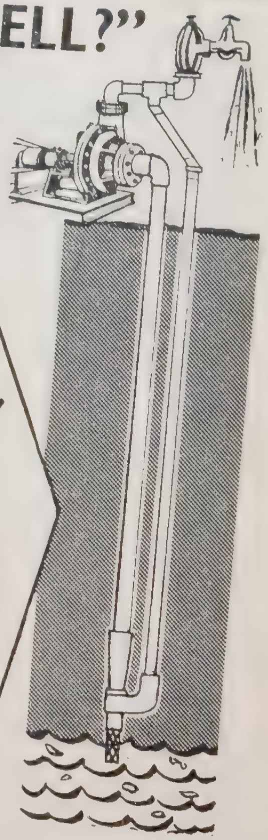

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	lb per acre
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Certified short-rotation rye-grass	[illegible]
Certified timothy	[illegible]
Certified cocksfoot	[illegible]
Crested dogstail	[illegible]
Certified white clover	[illegible]
Certified Montgomery red clover	[illegible]
Total	[illegible]

Such a mixture produced a general-purpose pasture which is capable of producing well in the early stages and of remaining useful for 10 or more years even though by that time browntop, sweet vernal and Yorkshire fog may have gained entry into the sward.

During the period between ploughing of the tussock and sowing of the grass low-lying areas are drained. Drag-lines have been used extensively in recent years and in many parts additional drainage is secured by the use of mole drains and sand-slot drains.

Development of Various Areas

Titipua

One of the earliest of the ploughable tussock areas to be developed on a large scale was the Titipua block, which was of about 4000 acres. Development began in 1926.

The method employed was to plough with a swamp plough to a depth of 8 to 9in. in early summer and to disc, roll and thoroughly work the following spring. One ton of carbonate of lime per acre was applied and a crop of swedes or yellow-fleshed turnips was sown with the ridger, 4cwt. per acre of a proprietary turnip fertiliser being sown with the crop. The swedes or turnips were fed off during winter, the grazed land disced thoroughly the following spring and a crop of rape sown in ridges. The rape was used for lamb fattening and winter feeding and in early spring the land was again disced thoroughly and rolled, worked and sown out in the following grass seed mixture: 20lb. of Certified perennial ryegrass, 10lb. of Italian ryegrass, 1lb. of timothy, 3lb. of Certified cocksfoot, 1lb. of Poa pratensis, 1lb. of Poa trivialis, 1lb. of Certified Montgomery red clover, 3lb. of white clover and 1oz. of yarrow: a total of 40lb. 1oz. per acre.

A dressing of 3cwt. of superphosphate was applied at sowing time. Occasionally oats were sown with the grass seed, but the best results with pasture were obtained on areas sown without the cover crop. If oats were sown with the grass seed, carbonate of lime at 1 ton per acre was applied at the same time. Otherwise the lime was applied at 1 ton per acre during the first year of the pasture's life; thereafter all pastures were given an annual topdressing of 2cwt. of superphosphate per acre.

An intensive form of controlled grazing was practised in the conversion of this area of tussock land to high-producing pasture. From November to March as many as 3 cattle beasts to every 4 acres in addition to sheep were carried to control the pasture growth. These cattle played a very important part in the development of the Titipua block, assisting consolidation and surface manuring, both of which are important in the maintenance of a high-producing sward.

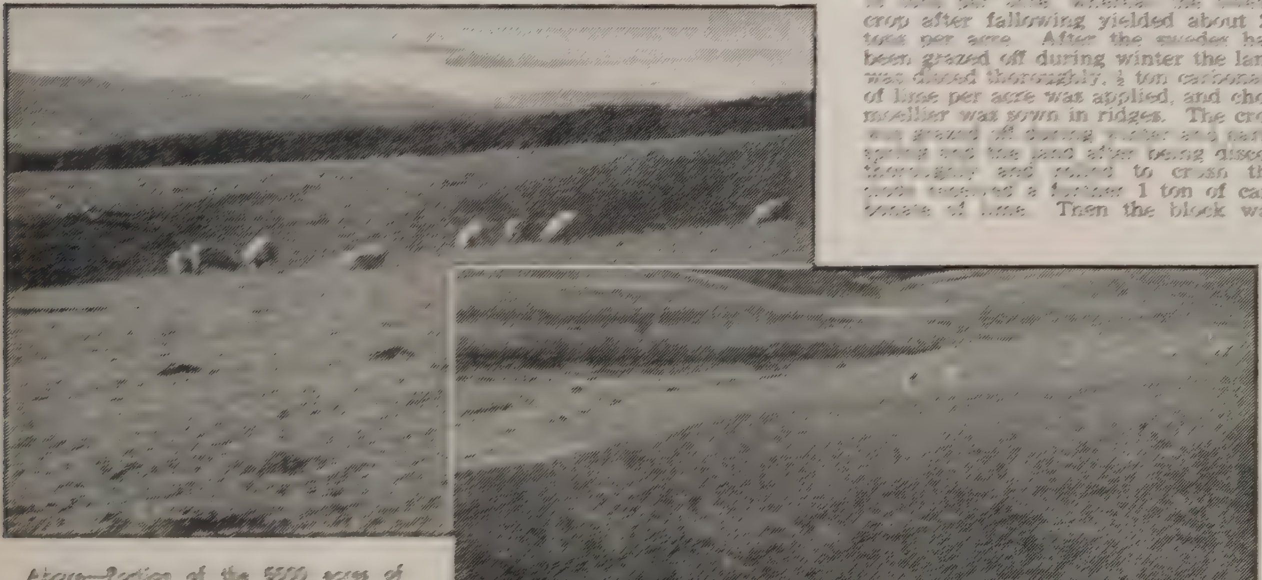
The carrying capacity of much of this partly developed, and in some areas abandoned, type of country was about 1 sheep to 2 acres; the entire 4000 acres was brought in in 10 years and at the end of that time the carrying capacity was 3½ ewes per acre and good crops of prime lambs were being produced. During the later years of development it was found that the lambs did better when a mineralised lick containing cobalt was used; previously rock salt had been used, but with the use of the mineralised lick the lambs went ahead more steadily.

In 1952 2800 acres of this block were acquired for resettlement. At that time the area was carrying 7598 ewes, 2317 hoggets and dry sheep, and 257 cattle. Up to the present 9 farms, each of between 280 and 320 acres, have been allocated to ex-servicemen.

Southdown

Southdown, an area of 5500 acres of the same type of country as the Titipua block, was brought in in 13 years after work began in 1934. Some of this block consisted of areas which had been cultivated previously and had reverted to browntop, tussock and gorse. These areas were dealt with first, being ploughed in July, cultivated, limed at 1 ton per acre and sown down in spring with a mixture of 20lb. of perennial ryegrass, 5lb. of Italian ryegrass, 3lb. of cocksfoot, 2lb. of crested dogstail, 4lb. of timothy, 2lb. of white clover and 1lb. of rape per acre. This mixture established well, and some of these areas were still in pasture 14 years after sowing.

Blocks which were still carrying the original tussock cover were ploughed with a swamp plough to a depth of 8in., usually fallowed for at least 12 months, with occasional discing, and disced and rolled. One ton of carbonate of lime was applied and swedes or yellow-fleshed turnips were ridged in in November. The fallow was found necessary, as on some of the blocks that were not fallowed the resultant swede crop was poor, yielding about 10 tons per acre, whereas the swede crop after fallowing yielded about 25 tons per acre. After the swedes had been grazed off during winter the land was disced thoroughly, ½ ton carbonate of lime per acre was applied, and chou moellier was sown in ridges. The crop was grazed off during winter and early spring and the land after being disced thoroughly and rolled to crush the clods received a further 1 ton of carbonate of lime. Then the block was



Above—Portion of the 5500 acres of Southdown where development was completed in 13 years. The area has now been subdivided for the settlement of ex-servicemen. At right—Fully developed pastures consist mainly of ryegrass, crested dogstail, and white clover and carry 3½ to 4 ewes per acre.

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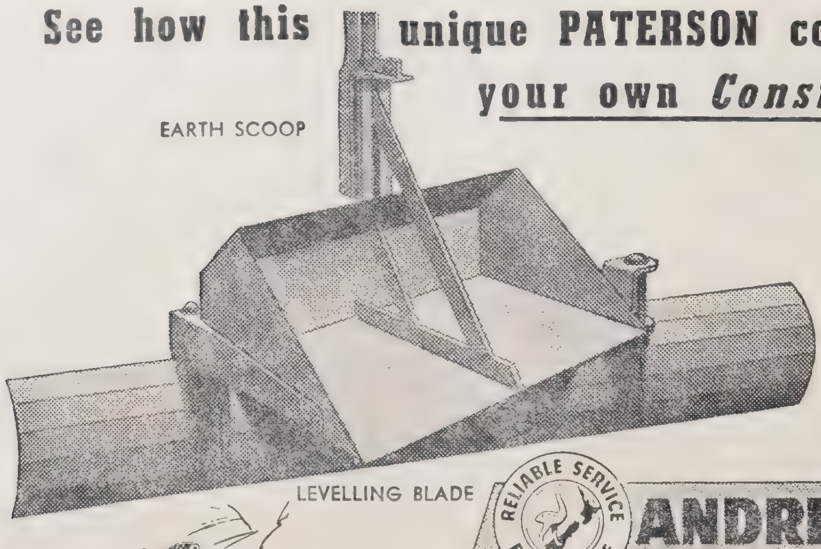

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sown out in the pasture mixture mentioned, except that on some blocks cocksfoot was not included. The fertiliser used with ridged crops was 2cwt. per acre of reverted superphosphate applied through the back box (with the seed) and 2cwt. per acre of a mixture consisting of 1 part of blood and bone, 1 part of Seychelles guano, and 3 parts of superphosphate applied through the front box of the ridger (below the seed); 3cwt per acre of the mixture used for the front box was applied at the time of sowing the grass seed mixture.

Ploughing and cultivation were carried on almost continuously and in some years up to 900 acres were under cultivation, being ploughed or fallowed, under turnips, or being prepared for sowing down to pasture. When it was established the sown pasture land was topdressed every year with 1 2/3cwt. of superphosphate per acre, except during the war years, when rationing permitted only 1 bag of superphosphate per acre every 2½ years.

Grazing management was important and both sheep and cattle were used; pastures were not permitted to get out of control, extra cattle being used to deal with any excess growth. Aberdeen Angus x Hereford cattle and Romney ewes and rams were used, a Romney stud being built up in later years.

Before development of this block production from it was negligible, as it was carrying only a few cattle. In 1947 about 10,000 ewes, 3000 to 4000 hoggets for replacements, and 300 breeding cows, the progeny of which were disposed of as 2-year-olds, were being carried. Since 1947 the property has been acquired for rehabilitation of ex-servicemen and subdivided into 11 farms of between 400 and 600 acres each, according to the quality of the land. Each unit is capable of running 1000 ewes with replacements and cattle.

Mount Linton

During the past 5 years upward of 2500 acres of tussock country has been converted to sown pasture at Mount Linton. The country generally was regarded as poor and before being developed was carrying only about 1 sheep to 3 acres. This area has been brought in at the rate of about 500 acres per year, the method adopted being to plough the tussock in late summer to a depth of about 8in.; this was varied according to the class of material to be ploughed in. Complete burying of the tussock and any scrub is essential. In this area burning of the tussock was found to be inadvisable, as the take of grass was poor on an area that had been burnt before ploughing. This was particularly noticeable on the steeper hill faces. The ploughed land is left to be weathered until early spring, when subsequent cultivation consists of discing thoroughly with tandem discs and the use of a specially designed clod crusher and leveller; the latter is important, as it makes a firm, level seed-bed.

Adequate liming of the land is a prerequisite for the establishment of grasses and clovers at Mount Linton as with other tussock areas in Southland. The pH of the clay land at Mount Linton is about 4.2 and to rectify the acidity carbonate of lime at 2 tons per acre is applied with a bulk-lime sower before the sowing of the grass seeds mixture. The mixture consists of 15lb. of perennial ryegrass, 15lb. of Italian ryegrass, 2lb. of crested dogstail, and 2lb. of white clover per acre. This is broadcast with 2cwt. per acre of superphosphate. Latterly the sowing of both the grass seed and superphosphate has been done by aeroplane, half the quantity being sown each way; good, even cover and establishment have been secured.

Grazing is controlled by the use of sheep and cattle and during flush periods stock are brought in off the run country for this purpose, so that the run country is benefited by the spelling and the sown grass is controlled and improved by the concentration of stock.

During the 2 years following the sowing at least 2 tons of carbonate of lime per acre is applied and annual dressings of 2cwt. per acre of superphosphate are made.

The new pastures are regarded as temporary and intended to last for about 6 years, after which they will be ploughed. A crop of ridged swedes will be taken (about 300 acres of swedes are required for winter feed each year) and permanent pasture sown the next year.

The method of converting this ploughable tussock land to pasture differs from those outlined previously in that pasture is secured on the first furrow and there is only a short fallow. The system is, however, successful, as the carrying capacity has been stepped up from 1 sheep to 3 acres to 2½ ewes per acre, and tussock land up to an elevation of 1500ft. has been developed.

Smaller Areas

A general outline of the methods adopted in converting three extensive blocks of ploughable tussock country has been given, but recently smaller areas have been developed by established farmers, who have used the implements, stock, and labour available from home farms. The method adopted is substantially as described in the section on current practices. In one instance, where about 700 acres are being brought in, the practice has been to plough in February and fallow until the following February or March. The area is then tripod harrowed, disced and topdressed with 30cwt. of carbonate of lime per acre, and left until the following November, when the land is worked fully for ridged, yellow-fleshed turnips. After the turnips are grazed off in winter the area is again disced and worked thoroughly. A further 30cwt. of lime per acre is applied and the area sown out in a permanent-pasture seed mixture under either oats, ryecorn, or linseed, according to the farm programme. The revenue from the nurse crop is used for the development of the area.

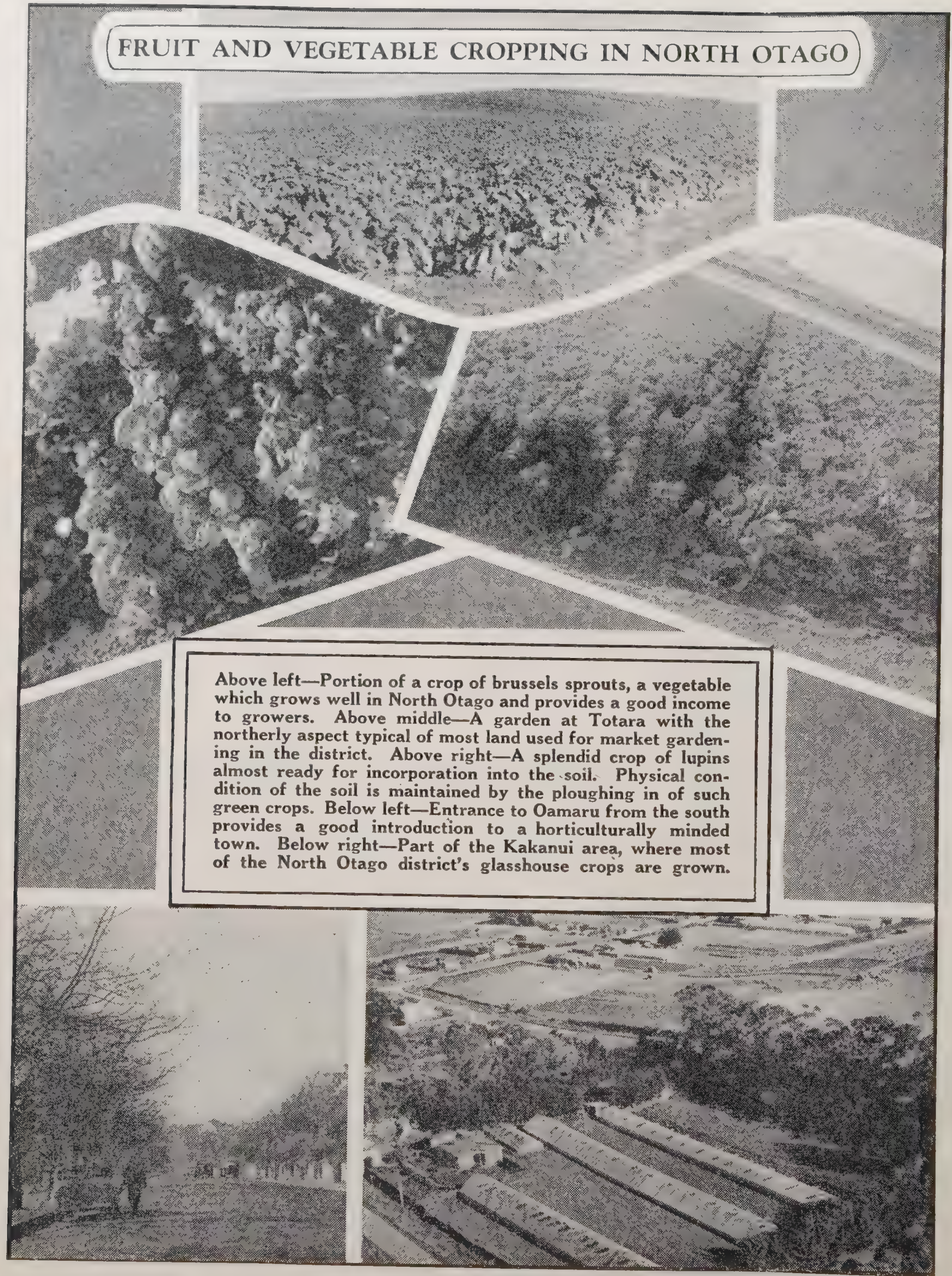
These areas are being used and developed in conjunction with already-developed farms, and it is therefore difficult to assess the carrying capacity accurately. As an example of potential, however, all sown grassland on one 1000-acre block which is being converted carries approximately 3½ ewes per acre. The first pasture in this block was sown down in 1939. Up to the present 450 acres have been sown down and this is carrying 1400 ewes and 600 hoggets.

Present and Future Production

The carrying capacity of the former red tussock country has increased very considerably in recent years. The number of breeding ewes in Southland has increased in the last 20 years from approximately 1,565,000 to 2,620,000. This increase is reflected in the number of fat lambs killed for export which, in the same period, has increased by over 400 per cent. Farms that 20 years ago were wintering 1 ewe per acre now are able to winter between 4 and 5 ewes per acre. Though this rate of stocking has been reached on a number of properties, the average carrying capacity of developed areas is about 3 to 3½ ewes wintered per acre.

Although a relatively small area of virgin red tussock country remains to be developed, there is still a large area of partly developed land which is capable of much improvement.

FRUIT AND VEGETABLE CROPPING IN NORTH OTAGO



Above left—Portion of a crop of brussels sprouts, a vegetable which grows well in North Otago and provides a good income to growers. Above middle—A garden at Totara with the northerly aspect typical of most land used for market gardening in the district. Above right—A splendid crop of lupins almost ready for incorporation into the soil. Physical condition of the soil is maintained by the ploughing in of such green crops. Below left—Entrance to Oamaru from the south provides a good introduction to a horticulturally minded town. Below right—Part of the Kakanui area, where most of the North Otago district's glasshouse crops are grown.

[Aerial photograph by Auster Airviews; all others on this and opposite pages by Robertson.

Fruit and Vegetable Cropping in North Otago

FROM a humble beginning in 1924 Mr. J. Tyson, of Kakanui, and Mr. T. Cooper, of Totara, North Otago, without knowing it became pioneers in that district of a horticultural industry of which they may well feel proud. True gardeners, both still preserve the respect of many competitors. In the difficult years and trying times for growers that followed, much productive land changed hands. In 1934 the first Chinese grower settled in the district on land which once had grown wheat. Now Chinese and European gardeners together crop the rich fields of North Otago, providing food all the year round for many thousands of city dwellers. The present state of fruit and vegetable production in North Otago is reviewed in this article by W. G. Crawford, Horticultural Instructor, Department of Agriculture, Oamaru.

NORTH OTAGO soil generally is naturally fertile, being equalled by that of few districts of New Zealand. Since the early days of its commercial cultivation it has been maintained in a high state of productivity by sound methods of soil management. The largest units of horticultural production in North Otago are at Kakanui and Totara, two areas in which horticultural crops overlap. A knowledge of the type of soil in these areas is essential to success with fruit and vegetable growing. The soils are very sticky and structureless when wet and are generally referred to as the "tarry" soils of North Otago. However, they do not extend throughout North Otago, but are generally confined to areas with highly calcareous subsoils.

Other land in North Otago used for the production of pip, stone, and small fruits and cut flowers consists of a friable loam of good depth. Most of the soils used for horticultural crops are rich in plant foods, retentive of moisture during dry spells, and well drained. The heavier, darker soils must be cultivated carefully because of their "tarry" nature. Soils of this type cannot be worked immediately after rain or if the land is wet from seepage or other causes, but as the rainfall for the district is low the soil becomes suitable for working a day or so after rain.

The climate of North Otago is well suited to commercial horticultural cropping during most of the year. However, the low average rainfall of 22in. is a serious handicap to summer cropping in some years, and growers have always concentrated as much as possible on autumn, winter, and spring crops. Moderate temperatures during winter and spring and large areas of fertile land with a northerly aspect close to the coast were the main factors which influenced the pioneers to begin horticultural cropping there.

The quantity of horticultural production, particularly of vegetables, in North Otago has increased strikingly since the beginning of the Second World War. Expansion has been most rapid in the Totara and Kakanui areas, where the area in such crops has increased by possibly half, compared with about a fifth in other parts of the district. At present about 1000 acres of market gardens are growing vegetables alone in North Otago, with possibly a further 125 acres in early potatoes and valuable crops of grapes and tomatoes in glasshouses.

Following are estimated annual areas or production of the main horticultural crops in North Otago:—

Tomatoes	220 tons
Early potatoes	125 acres
Other vegetables	1000 acres
Grapes	32,000lb.
Stone fruits	9000 bushel cases
Pip fruits	10,000 bushel cases
Small fruits	1000 bushels

The system of cultivation on the "tarry" soils differs somewhat from that followed elsewhere. "Tarry" soils are very exacting in their requirements if they are to be brought to the best possible tilth. Most of the large holdings are worked by contractors who specialise in rotary-hoe cultivation. This system is favoured by most growers, as the work is carried out in one operation.

On other soil types rotary hoeing, ploughing, and other methods are used. In general, working of the land in the district is very highly mechanised. The land is fairly clean and inter-row cultivation for weed control is not a serious problem.

Emphasis on Vegetables

Vegetables occupy by far the largest area and production per acre is very high compared with that from other South Island districts. North Otago growers have always aimed to produce the vegetables most sought after during seasonal shortages. Though the climate (which is probably the biggest single factor in vegetable production) is suitable for a wide range of garden crops, cropping is specialised to a greater extent than is generally realised even by North Otago people. Many growers specialise in growing crops such as brussels sprouts, winter broccoli, lettuce, early potatoes, and peas. On the gentle hill slopes of Totara and Kakanui, with their northerly aspect and closeness to the coast, early crops can be grown with a fair chance that they will not be affected unduly by frosts.

However, the kind of crops produced varies considerably from season to season, being determined chiefly by market requirements and rotation for soil and crop hygiene.

A view of the Totara district, with Kakanui in the background. These two areas contain the largest units of horticultural production in North Otago. The railway is Whitecraig Siding, where most of the produce of this area is loaded. Also in the background are a limeworks and an Oamaru white-stone quarry.

Glasshouse Crops

Tomato and grape growing in the Kakanui area has been fairly stable for a number of years. The growing of these crops is highly specialised and calls for long hours of hard work during the season. Chances are never taken with these crops under glass, the strictest attention being paid to all phases of the work throughout the season. Glasshouse cropping is carried out successfully throughout the district, the biggest concentration being at Kakanui.

About half of all North Otago glasshouses are heated, the order of preference for fuels up to the present being oil, coal and coke, and electricity. Many growers have installed heating equipment during the past year. Heating has not only provided insurance against crop failures in unfavourable weather, but also has been chiefly responsible for greater regularity of supplies over a longer period of the year with less seasonal variation in returns. Partial heating of glasshouse properties also results in a lessening of the demand for seasonal labour for thinning crops and other cultural operations.

Fruit Production

In the extreme north of North Otago, about 40 miles from Oamaru on the south bank of the Waitaki River, most of the stone and pip fruits produced in the district are grown on rich, deep, friable soil. Though the number of growers in this locality is not large, production is good and the fruit of excellent quality. The climate closely resembles that of Central Otago, with long, warm to hot, dry summers and cool winters. A good rainfall during winter or rains early in the growing season are very desirable features characteristic of this area.

Much of the stone fruit from this area is consigned to the North Island, the balance being distributed over most of the principal South Island towns.

Flower Growing

The growing of flowers is not confined to a small number of people, but is carried out by a large number on a small scale. As much of the district is limestone country, carnations are selected as the most profitable of all cut flowers; chrysanthemums are grown for sale in both summer and winter. Bulb growing is a remunerative sideline for many people.

Small Fruits

Small-fruit growing is confined mainly to strawberry and raspberry production, but gooseberries and currants also grow well.

Cultural operations for small fruits are much the same as in other districts, but some modification of soil management is sometimes advisable on "tarry" soils. Plants are usually set out as early as possible in autumn to give them every opportunity of making strong roots before winter frosts begin. Production costs are difficult to determine accurately, but it would seem that to supply present demands the area in strawberries could be increased with a fair margin of profit to the grower.

Distribution of Produce

Transport from the main producing areas of North Otago is mainly by rail and to a smaller extent by lorry. An excellent goods service is provided by the railways, goods loaded one day usually arriving at their destination in the South Island in time for sale on the following morning. Railway sidings are close to all large producing areas, so long hauls to railheads are not necessary. Whitecraig Siding and Maheno are the principal loading centres for the main producing areas.

In general, about 70 per cent. of the district's output is consigned to Dunedin and southern markets and the balance to Timaru and Christchurch. During periods of shortages the North Island also receives consignments of both fruit and vegetables. An endeavour is made to ensure reasonable continuity of supply of all main-crop vegetables throughout the year, but summer shortages may be caused by climatic variations.

Labour

Most of the labour employed is permanent, though casual labour is engaged for seasonal work.

Most of the labour for the Totara and Kakanui districts is drawn from Oamaru, and that required for fruit picking and packing further north is usually available readily from Kurow.

Prospects for Future

Two factors chiefly responsible for the slow increase in production in North Otago in the past were uncertainty of the labour supply and inadequate and unsuitable transport. These difficulties have been overcome in recent years by the development of passenger and goods transport services. The district is now very favourably served by transport, facilities being available for the consignment of goods to markets both north and south of Oamaru.

North Otago can be strongly recommended for the growing of vegetable crops on a large commercial scale, as climate and soil are very favourable. Pip- and stone-fruit growing on a commercial scale cannot be advocated for the district in general; any increase in such crops should be confined to inland areas. Strawberry growing, on the other hand, is a very valuable sideline and an acre or two should give a substantial return.

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BOOK REVIEW

"Great Farmers": J. A. Scott Watson and M. E. Hobbs

"GREAT FARMERS", by Sir James A. Scott Watson and Mary Elliott Hobbs, deals essentially with the work of persons and societies in the advancement of British farming since the latter part of the 18th century. New Zealand readers will find much of interest in the description of British farming in the middle of the 19th century, when this country was colonised. Subsequent progress in thought and practice in relation to New Zealand farming is also traced, particularly in the sphere of pasture establishment and management. The last two decades of the 19th century were marked by a very real interest in pasture production problems both in Britain and New Zealand and gradually that interest shifted from controversy to experiment. The early experimental work of Sommerville at Cockle Park on pasture topdressing and the much later work of Stapledon at Aberystwyth were of great importance in the development of intensive grassland farming in this country.

The book appropriately ends with the sentence: "But it will continue to be true that the advance of our own British farming will depend in the main on the ingenuity and originality of the few, combined with the progressive spirit of the many".

—P.W.S.

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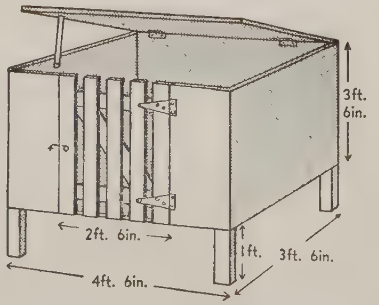

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Copper Deficiency in Cattle and Sheep

Most of the reclaimed swamp lands and peaty soils of New Zealand so far examined have proved to be copper deficient, and a deficiency has also been recorded on some pumice soils and peat-pumice mixtures. It has been demonstrated that copper deficiency is responsible in certain cases for ill health, losses, and low production in stock on these areas. Various methods of supplying the deficient element and details of the improved results which have been achieved where this has been done are discussed in Bulletin No. 238, "Copper Deficiency in Cattle and Sheep", which can be procured free at any office of the Department of Agriculture.

◆

Paspalum in Bay of Plenty District

By A. V. ALLO, Instructor in Agriculture, Department of Agriculture, Tauranga

OF all the grasses available to the New Zealand farmer it is doubtful if any has been the subject of as much discussion as has paspalum (*Paspalum dilatatum*). In some quarters this grass is regarded highly; many farmers on the other hand are antagonistic to it. This article has been prepared with the purpose of trying to evaluate its worth under Bay of Plenty conditions.

PASPALUM is a native of tropical or semi-tropical climates and therefore needs a warm summer climate before it will produce best. It does not like severe winter cold, so that the two demands of warm summer and mild winter temperatures restrict the areas where this grass can be of greatest value to the North Auckland peninsula and the coastal districts of Auckland Province. The grass is not restricted to these areas, however, as it is found frequently in South Auckland, the Waikato, Taranaki, and Hawkes Bay.

Paspalum will produce best only when the soil is moist, and thus the drained swamp areas of warmer districts provide an excellent habitat. Paspalum is very resistant to drought and will hold on amazingly well in a dry spell, although not producing anything like the bulk of fodder that it does in a wet season. During a really dry spell in Bay of Plenty paspalum will still give a ground cover and a picking of feed long after all other pasture species have dried up completely.

Effect of Fertility Level

Paspalum also requires conditions of satisfactory soil fertility, and one of the main causes of the low production of some paspalum pastures is that the fertility level is too low to permit the grass to grow properly. Under low-fertility conditions the twitchy habit of paspalum tends to permit it to become sodbound and a low-producing sward will result. Low fertility will also encourage heavy seeding and stalky growth rather than the production of palatable herbage.

If climate and soil fertility are satisfactory, paspalum grows prolifically and is capable of producing heavy crops of hay and large amounts of palatable fodder.

In Bay of Plenty paspalum normally commences its growth in November, although in an early, warm season it is not uncommon to see it producing appreciably in October. Growth continues throughout summer, reaching a maximum in January, and normally ceases with the onset of cold nights in April and early May. Thus under favourable conditions paspalum is capable of producing a large quantity of fodder for 6 months of the year. It is little wonder, therefore, that paspalum is so popular with nearly all farmers in Bay of Plenty.

Paspalum is of greatest value when it is a constituent of a mixed pasture rather than when it is dominant. The best sward for Bay of Plenty conditions is undoubtedly a mixed association of ryegrass, white clover, and paspalum, which is probably the highest-producing type of sward in New Zealand. It is sometimes maintained that this sward cannot be held and will tend to revert to one dominated by paspalum, but there are many pastures in Bay of Plenty which completely disprove this assertion. Indeed, some of the highest-producing pastures in the area are those of the ryegrass, white clover, paspalum type. Skilled management is needed, but there are few grasses which will give a better response than paspalum to good management.

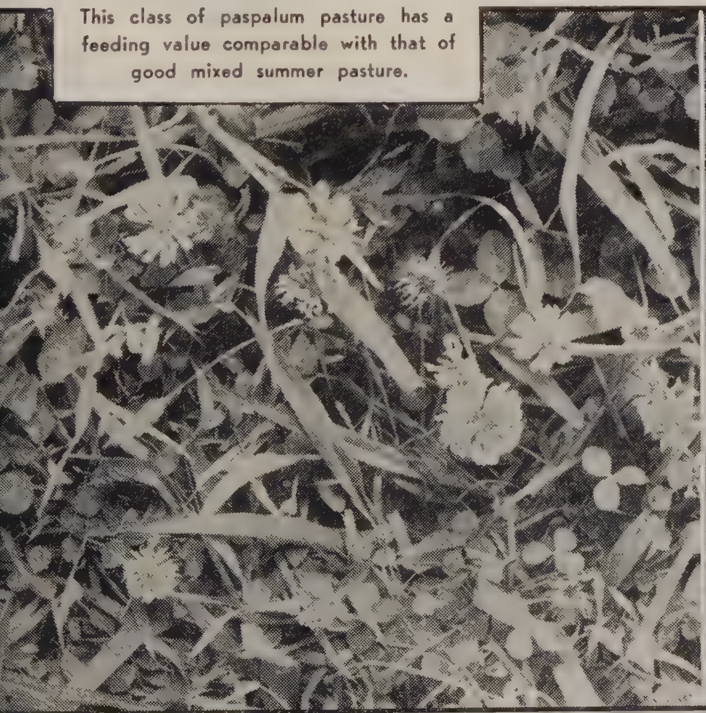
Establishment on New Country

In the past paspalum has never been particularly easy to establish on new country. The seed requires high soil temperature and adequate moisture before it will germinate, and the normal practice of including paspalum in the autumn-sown pasture mixture usually results in a very slow establishment of this species. This is not of any great moment on a farm where paspalum is plentiful in the existing pastures, but it is of great importance to the farmer developing new country. In addition to providing valuable feed in a time of normal shortage on new country paspalum is of great value in holding the new sward together and helping to minimise the ravages of grass-grubs.

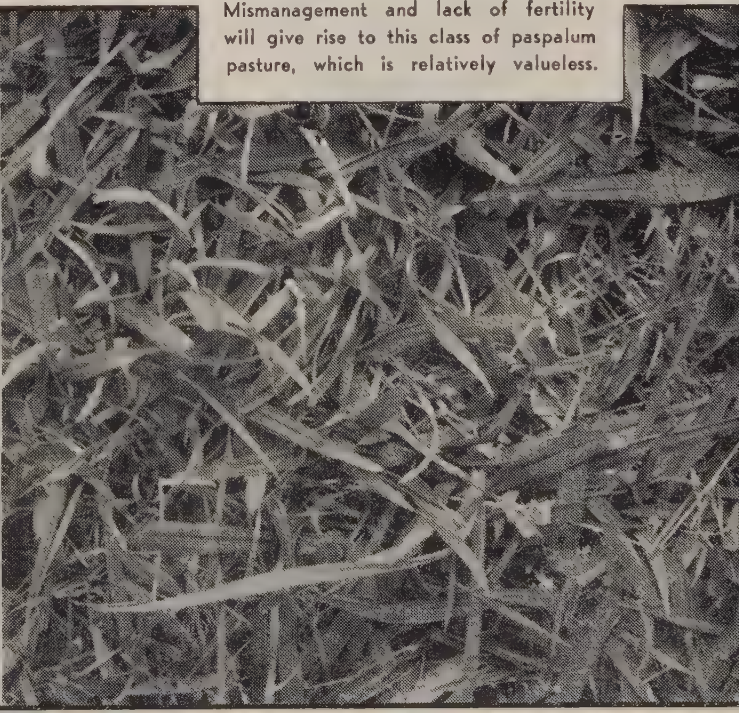
Over the past few years methods have been devised to accelerate the establishment of paspalum on new country. They are all based on the fact that the seed requires warmth and moisture if it is to germinate rapidly. On some farms paspalum at the rate of 5 or 6lb. per acre is sown in November with 4 or 5lb. of red clover, the balance of the grass seed mixture being oversown in the following autumn. Other farmers have sown paspalum and red clover with their swede crop, oversowing with the rest of the grass seed mixture in the autumn of the year following the feeding off of the swedes. Both these practices give excellent results and will give a good cover of paspalum much more quickly than when the seed is sown in autumn.

Introduction into Existing Pasture

The introduction of paspalum into an existing pasture lacking this grass is more difficult than getting it to establish in new swards. Results from oversowing of paspalum seed are not good, and this practice is not recommended. One farmer has had success from adopting the novel method of introducing paspalum into a pasture by mixing the seed with chaff which he fed out in troughs to dry stock in the paddock in which he wanted to establish paspalum. This



This class of paspalum pasture has a feeding value comparable with that of good mixed summer pasture.



Mismanagement and lack of fertility will give rise to this class of paspalum pasture, which is relatively valueless.

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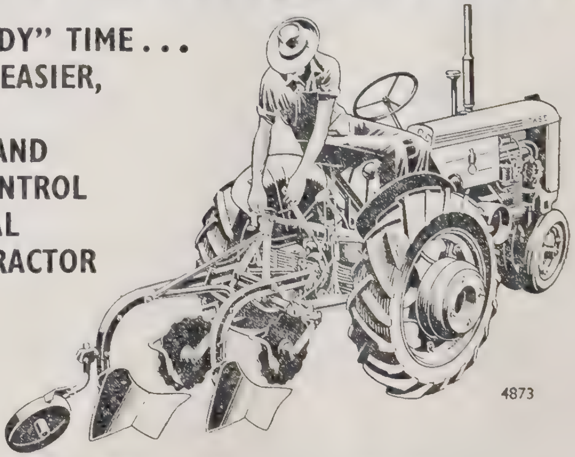

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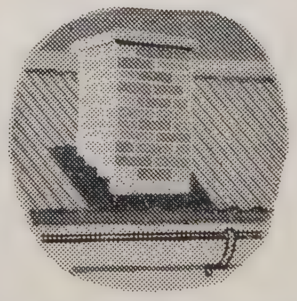

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was done in September and the troughs were shifted to new parts of the paddock every day or two. The seed was eaten with the chaff and was excreted with the droppings. No harrowing was done and the paspalum seed had an excellent medium for germination and development. By summer the paddock had an excellent sprinkling of strong and healthy young paspalum plants and the following summer there was an excellent mixed sward containing ample paspalum.

Management

Once paspalum is in a pasture management must encourage it to give maximum growth without crowding out the associated ryegrass and clovers. This is the key to successful handling of paspalum. Much of the criticism of this grass has been made by those who do not know how to manage it.

Paspalum is most nutritious when it is up to 4in. high, and for best results it should be grazed at this stage. In summer its growth is so prolific that frequently it gets out of hand, and it is not uncommon to see cows grazing in paspalum 2 to 3ft. high. Many farmers have found to their cost that grass at this stage cannot produce milk. It is almost impossible to handle paspalum efficiently without using the mower to top when necessary.

Where an electric fence is being used to give cows a fresh daily break the break should be larger than is usual when a ryegrass-white clover pasture is being break-grazed to compensate for the paspalum growth being only 4in. high. As soon as the paddock has been fed off it should be topped, when it will come away fresh and vigorous for the next grazing.

Feeding Value

In the past very little has been known of the feeding value of paspalum and many have condemned this grass through ignorance of its worth. Recent work done by Coup and Dunlop at the Department of Agriculture Animal Research Station, Ruakura, on digestibility trials with paspalum has at last given some exact information of its feeding value. This information has shown how fallacious was the argument of those who said that paspalum was of little or no use for butterfat production and has vindicated the judgment of the great body of farmers who for years have been convinced of the merits of the grass.

It has now been proved that young paspalum is comparable to summer-grown, mixed dairy pasture in digestibility and nutritive value and that paspalum of intermediate maturity is comparable to silage. As it matures the grass drops in feeding value, so that mature paspalum resembles hay in nutritive value. The conclusion is that paspalum could be used instead of silage as a standby feed in autumn.

The practical implications of the research work are of considerable importance, as they indicate the basis upon which a paspalum pasture should be managed. The necessity of grazing this grass at its most productive stage is stressed, and it has been proved that in districts to which it is suited paspalum has few equals as a producer of summer and autumn feed.

Sodbound Swards

Common reasons for paspalum pastures becoming sodbound and low producing are lack of topdressing and inadequate control of excessive growth. When a pasture has got to the sodbound stage it has usually lost all the associated ryegrass and clovers. The bringing back of a deteriorated pasture of this type is not difficult. First the cause of deterioration must be found —usually a fairly simple matter—so that management may be improved. Overcutting for hay may have reduced the potash level of the soil to such a low degree that clovers have disappeared, or excessive growth of paspalum over a number of years may have smothered out everything else.

There are three methods of renewing a sodbound paspalum pasture: It may be given a drastic surface working in autumn and oversown with a ryegrass-white clover mixture; it may be disced with a heavy set of discs and a seedbed prepared; or the area may be ploughed and regrassed. All three methods are effective and have their place. If a pasture is not badly sodbound, renovation will give excellent results provided surface working is adequate, but if a paddock is thoroughly sodbound it is preferable to plough and resow.

Main Points

The main points about paspalum are:—

1. It will produce large quantities of fodder where climate and soil fertility are satisfactory.
2. It is of great value in producing feed at a time of the year when other pasture species are relatively nonproductive.
3. It should be grown as a species in a mixed pasture—in association with ryegrass and white clover. A sward of this nature is probably the highest-producing possible under normal farming conditions. Under no circumstances is a sward of pure paspalum desirable.
4. Paspalum up to 4in. high has excellent feeding value for dairy stock. Feeding value deteriorates as it becomes more mature.
5. Surplus growth must be topped; growth should never be allowed to get out of hand.
6. It is easy to establish provided the seed is sown in October or November.
7. Soil fertility must be maintained by adequate dressings of phosphates and where required potash and lime.
8. A sodbound paspalum pasture can be restored easily either by renovation or by ploughing and resowing.

References

"Digestibility Trials with *Paspalum dilatatum*", New Zealand Journal of Science and Technology, vol. 33A, No. 4, page 1, M. R. Coup and A. A. Dunlop (1951).

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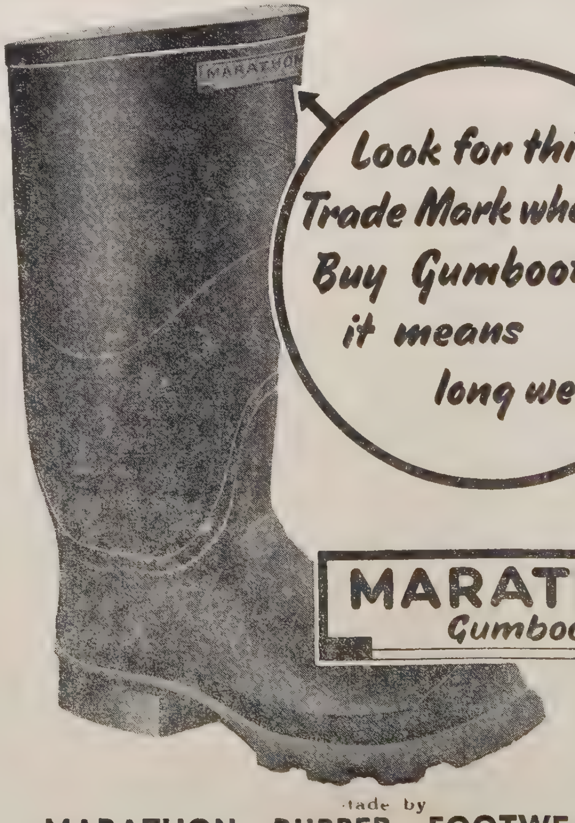

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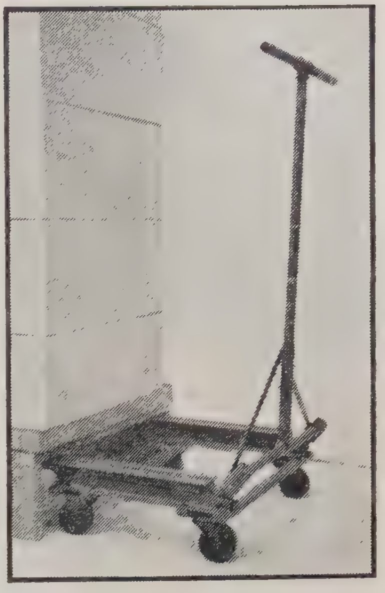
Constructing a Honey-house Bogey

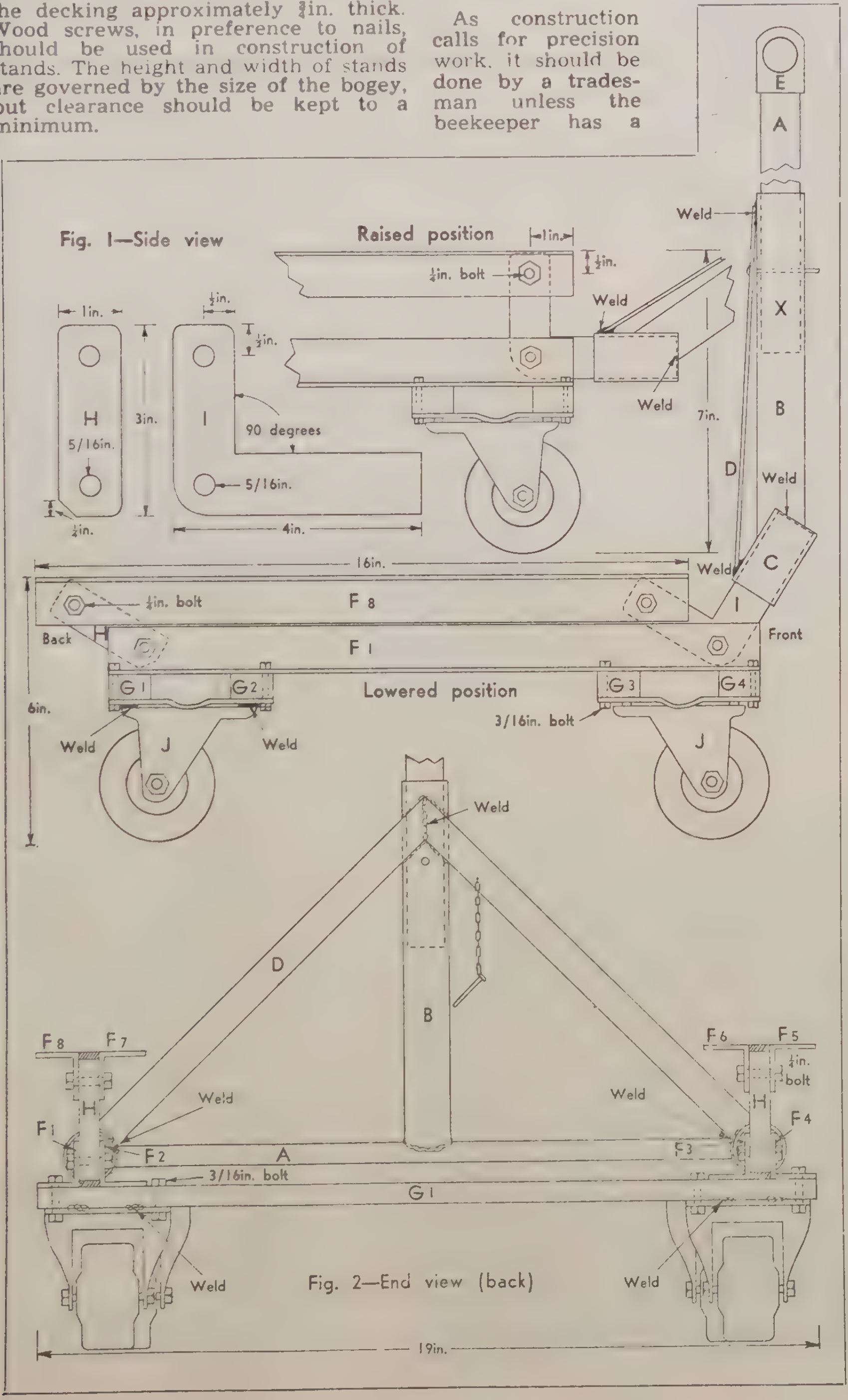
HONEY-HOUSE bogeys such as the one described in this article by D. A. Briscoe, Apiary Instructor, Department of Agriculture, Greymouth, are becoming important pieces of honey-house equipment. Without them beekeepers are faced with a lot of heavy work in the handling of extracting supers, cases of packed honey, etc.



TO operate the bogey it is first necessary to construct small stands (preferably from timber) upon which the extracting supers, etc., are placed (in drip trays). Stands should be made open both back and front, the sides of timber at least 1in. thick and the decking approximately ⅜in. thick. Wood screws, in preference to nails, should be used in construction of stands. The height and width of stands are governed by the size of the bogey, but clearance should be kept to a minimum.

The body of the bogey illustrated is run under a stand, and with a backward motion of the bogey handle the stand and contents are lifted clear of the floor (by approximately 1in.) and can be moved about at will.

As construction calls for precision work, it should be done by a tradesman unless the beekeeper has a thorough knowledge of metal work and welding and has at his disposal the necessary tools and machinery. The bogey should be as light as possible yet strong and should be capable of lifting 300lb or more.



As the body of the bogey has to pass under the stand, it should be as low as possible and not more than 6in. high in its lowered position. With the bogey 5 or 6 full supers of honey can be moved about the honey-house with little effort.

The dimensions over-all are: Length, 16in.; width, 19in.; height in lowered position, 6in.; height in extended position, 7in.; length of handle (detachable), 26in.

Materials Required

A—Approx. 5ft. of ½in. galvanised water pipe

B—8½in. of ¾in. galvanised water pipe

C—2 pieces of 1in. galvanised water pipe each 2in. long

D—1 piece of ¾in. x ⅛in. metal for handle brace (approx. 2ft.)

E—One ½in. or T joint for galvanised water pipe

F—8 pieces of 1in. x ⅛in. angle iron 16in. long

G—4 pieces of 1in. x ½in. steel plate 19in. long

H and I—Cut from 1in. x ½in. steel plate

J—4 heavy, metal, ball-bearing castors, 2¾in. in diameter; 16 3/16in. x 1in. high-tensile steel nuts and bolts; 8 ¼in. x 1in. high-tensile steel nuts and bolts

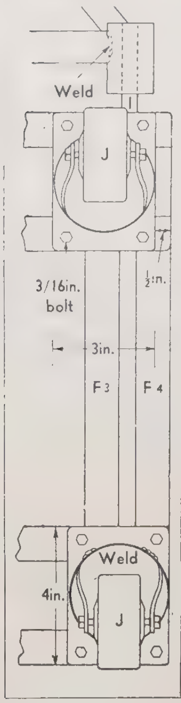
Note: The letters refer to those on the diagrams.

Details of Construction

It is necessary that the assembly, with the exception of the two bottom outside angle irons F 1 and 4 (Figs. 2 and 3), be welded to ensure a more rigid and permanent fixture.

Provided the measurements are followed exactly, construction should not prove difficult, and it is recommended that a good centre punch be used for marking the positions for bolt holes before drilling. Care is essential in making the lifting mechanism H and I and in fitting it to the angle irons F. The positions of the holes in H and I are shown by Fig. 1. **It is important that the angle between the two arms of I should be exactly 90 degrees.**

Fig. 3
Bottom view



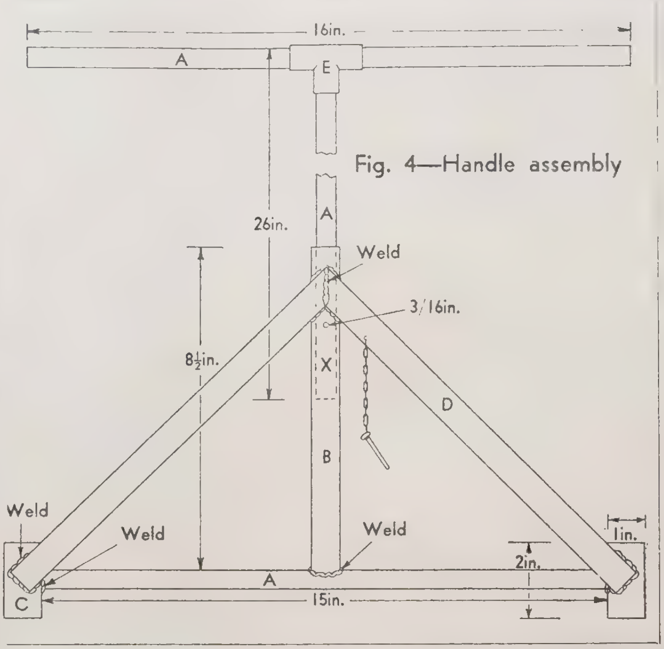


Fig. 4—Handle assembly

The positions of the holes in all the angle irons F should be the same —1in. in from the end and ½in. down from the top edge.

The castors should be placed in position first and Fig. 3 shows their relative positions. The two fixed ones (rear) are bolted to the ends of the two steel plates G 1 and 2 (Fig. 1) and welded to prevent them from swivelling. The steering castors are placed ½in. in from the ends of the steel plates G 3 and 4, thus allowing the castors to rotate without any part of the wheels protruding beyond the edge of the bogey. This insetting of the two steering castors is essential; otherwise the castors will be prevented from rotating by the sides of the stand under which the bogey is worked.

The bolts on the outer edges of the castors also pass through the outside angle irons F 1 and 4 (Figs. 2 and 3). To enable the lifting mechanism to be reached easily it is necessary that these two angle irons should be held in position solely by these bolts. Once the angle irons F 1 and 4 are in place the lifting pieces H and I can be fitted and the angle irons F 2 and 3 placed and welded in position. The remaining angle irons (F 5, 6, 7, and 8, Fig. 2) are then secured.

Handle Assembly

The bogey should be finished before assembly of the handle is attempted. The detachable part requires little explanation. The lower 4in. of A is turned down sufficiently to fit neatly inside B (X, Fig. 4), and a hole and pin of sufficient size (about 3/16in.) is provided to lock the joint. The upper portion of the handle is of two 7½in. lengths of pipe threaded and screwed into the T joint, and this in turn is screwed on the handle length.

The lower portion (A, B, and D Fig. 2, and C, Fig. 1) should be assembled as far as is possible on the bogey so that the correct upright position of the handle is attained when the bogey is at a lowered position.

The two pieces of 1in. pipe C should now be placed on the arms of the lifting pieces I and welded in position (Fig. 1). A space of about ½in. is sufficient between the end of the bottom angle irons F 1 and 4 and the end of the pipe C. A piece of ½in. pipe with a central marking is then cut to fit neatly between the two pieces C (just fitted) and welded in position (A, Fig. 4).

It is important that the bogey should now be placed in a lowered position (Fig. 1). The 8½in. length of ¾in. pipe with the handle in position is then placed on the central mark of the piece A just fitted. When a check has been made to ensure that the lifting part of the bogey is in a completely lowered position and the assembly, now held upright, is at a position approximately 90 degrees to the top of the bogey, the joint between B and A (Fig. 4) should be welded securely. The bracing strips D (Fig. 4) are placed and welded in position last.

When the handle is lowered and the lifting part of the bogey is fully extended the position of the handle should be at an angle of about 34 degrees to the top of the bogey (Fig. 1).

Acknowledgment

The assistance of Mr. R. V. Glasson, of Blackball, in making details of the bogey available for publication and for supplying material for photographing is acknowledged.

THE farm mower, if not treated with respect, can be an extremely dangerous implement. The illustration shows a farmer inspecting the cutter bar while standing in front of it. It does not show that the power take-off is in gear, the tractor is in gear, and the engine is running. The fact that the driver's foot is holding the clutch disengaged does not make the mower safe. His foot could slip or he may move it without thinking. Play safe! The cutter bar can be seen just as well from the rear.

—D. F. SCOTT,
Farm Machinery Instructor, Department of Agriculture, Auckland

Importance of Creep in Profitable Pig Production

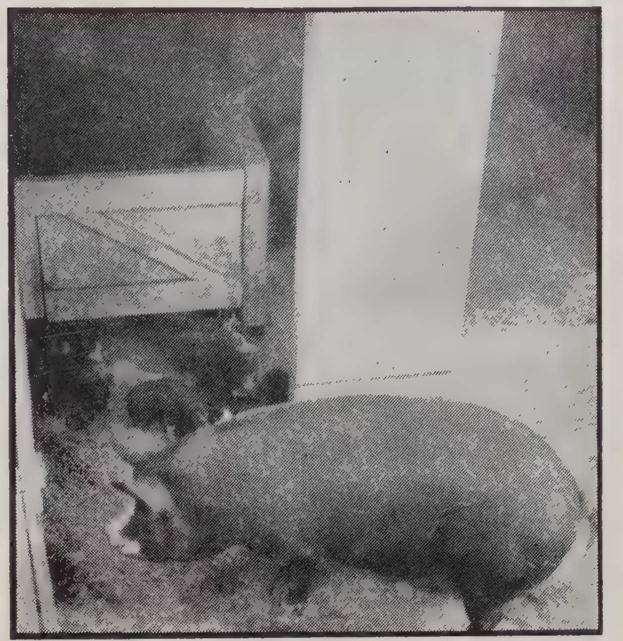
THE successful use of the creep for feeding piglets that are still being suckled by the sow is of the greatest importance in pig production. In this article, I. H. Owtram, Extension Officer in Pig Husbandry, Department of Agriculture, Wellington, deals with this aspect of pig production.

RECENT research work in New Zealand into the efficiency of food conversion by pigs has emphasised a fact, which, though well known to a few producers, appears to be overlooked by most. This is that the cheapest weight a pig ever puts on is that which it gains before being weaned. It was found that during the first 4 weeks of a pig's life, when it was almost entirely dependent on the sow for its food, 4 food units or pounds of feed were required to increase the total weight of the litter by 1lb., but that during the second 4 weeks (from 4 weeks old to weaning), when the piglets were receiving feed in the creep, it required only 3 food units to increase the litter weight by 1lb. These 3 food units include both the feed consumed by the sow and the food used by the litter in the creep. The 4 food units required during the first 4 weeks were practically all consumed by the sow.

These results show very clearly that during the last 4 weeks before weaning piglets can make much more efficient use of food fed to them direct in the creep than when that food is fed to them through the sow.

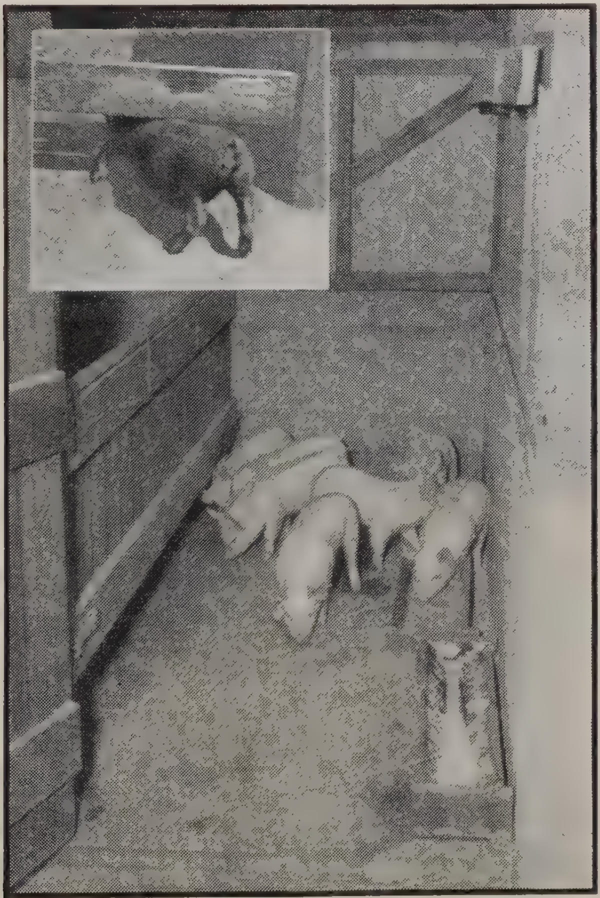
Sow's Milk Production

The milk production of sows has been found to increase up to the fifth and sixth week after farrowing, but after the the third week it does not increase sufficiently to supply the litter with all the food it requires for maximum growth rate. The result is that a litter that has no access to food in a creep, after making satisfactory growth for the first 3 weeks, tends to stand still for a period (during which piglets start to take food out of the sow's trough) and then to grow at a much slower rate than a litter that has had constant access to food in a creep from the time the litter's appetite outstripped the capacity of the sow to feed it.



["*New Zealand Farmer*" *photo.*

Covered creep built in at the side of the farrowing house.



Piglets in covered creep at the side of the farrowing house. There are separate troughs for dry meal and for milk. Inset—The entrance to the creep must be high enough for the piglets to go under it without risk of injury; that shown is too low.

Types of Creep

The creep is essentially a place where the piglets can go to feed and the sow cannot. The simplest type consists of rails placed across a corner of a paddock so that the piglets can get under them. It is more satisfactory to place the creep in the farrowing house, either as a permanent, built-in feature or so that it can be moved easily. If the creep is under the roof of the farrowing house, both the meal that is fed and the piglets are protected from the weather, which is a distinct advantage. The opening through which the pigs enter the creep should be from 9 to 12in. high. If it is too low, there is risk of injury to well-grown piglets before they are weaned.

The earlier it is possible to get piglets accustomed to using the creep the better; some coaxing may be necessary to achieve this. A handful of dry meat meal or pellets made from fat and meat meal scattered on the floor of the creep when the litter is between 2 and 3 weeks old is very useful. In addition the sow can be let out and the litter shut in the farrowing house for an hour or two to make the pigs sufficiently hungry.

Suitable Feed

Successful creep feeding consists of keeping a supply of food (dry meal) always available for the piglets, either in a self-feeder, which reduces the labour required considerably, or in a small trough. It is not possible to keep a constant supply of skimmed milk in the creep and this should be fed in small quantities as often as is practicable in a separate trough. A very satisfactory meal mixture is two parts of barley meal and one of meat meal. In districts where maize can be grown, whole maize can be used with success in the creep; it is better to shell the maize than to feed it on the cob. It can be fed in a self-feeder.

Piglets that have no creep have to rely on what they can get out of the sow's trough when she is fed. The sow has no difficulty in getting nearly all the feed and as she will be fed only two or three times a day, there are long periods when no extra food is available for the piglets.

Research has shown that piglets immediately after suckling the sow go into the creep and eat a little meal. As piglets suckle from 16 to 18 times every 24 hours, and do so just as often during the night as during the day, the necessity of having meal always available in the creep is obvious, if the maximum results are to be obtained.

Heavy Weaners

Production of large litters of heavy, healthy weaners is of the greatest importance in ensuring success in pig production, and to do it creep feeding is essential. Creep-fed piglets suffer little if any check at weaning and are much less susceptible to disease. Another fact of great importance, established by recent research work, is that the total amount of food consumed by a litter shows little variation, despite big differences in the milk production of the sow, when the litter is creep fed. In other words, what piglets do not get from the sow they get from the creep This emphasises the importance of the creep and also shows why the creep enables a litter to even up in weight; piglets that are lighter at 3 weeks than others in the litter, due perhaps to their having a less efficient teat, are able to make as good growth rate, and sometimes better, than their mates.

Many sows have already farrowed their spring litters and many more will do so during the next few weeks. To make sure that the maximum possible number of heavy, healthy weaners are produced from these litters they must be provided with a creep as soon as they start fossicking for more feed. The troughs must be cleaned and refilled regularly.

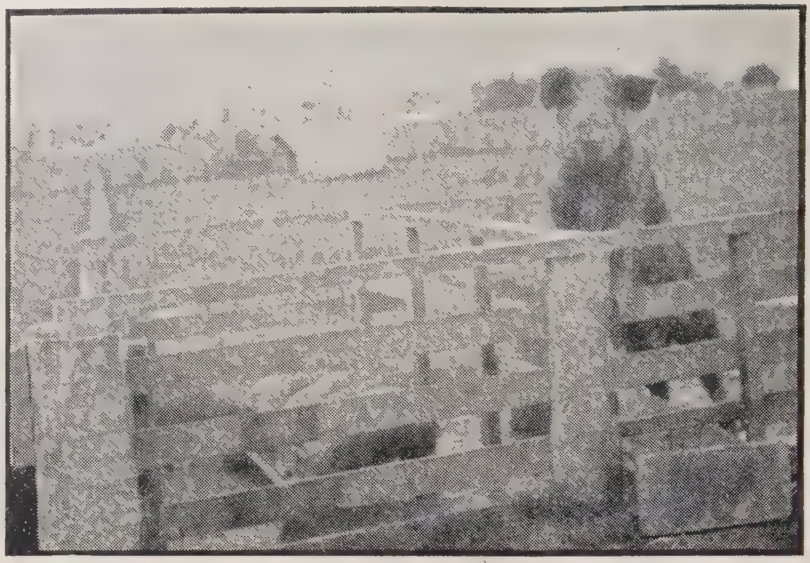
Pigs are too valuable for producers to neglect any point that will increase their efficiency, and the use of a creep is one of the most important.

The soundest reason for using the creep to assist in obtaining heavy weaners is that the heavier pigs are at weaning the sooner they will be ready for market. Having got well started in taking food from a trough, the creep-fed pigs tend to suffer less check at weaning. The following table gives a growth expectancy based on recording-club figures.

EXPECTED LIVEWEIGHTS OF PIGS ACCORDING TO WEANING WEIGHTS

Weight at	Liveweight (lb.)		
Weaning (8 weeks) ..	40	34	28
16 weeks	100	85	70
26 weeks	200	170	140

After pigs have been managed well up to the weaner stage they must next pass through the critical immediate post-weaning stage successfully. During that stage their food should include ½ to 1lb. of good-quality meals per pig per day.



["Dairy Exporter" photo.

Above—Open-air creep in a corner of a paddock. Below—Poor weaners, the result of neglecting creep feeding.

Flight Strips for Topdressing Aeroplanes

AS the safety factor is vitally important in locating flight strips for topdressing aircraft in hill country, the length and width of the strip must be considered in relation to slope, wind direction, and obstructions. Serviceability of the strip, freedom from mud and dust, and provision of a good braking surface depend largely on soil types and methods of construction. Efficient drainage can be provided by sound constructional methods which ensure thorough consolidation of the soil.

In general, surfacing the strip with topsoil is undesirable, because hard-wearing turf grasses grow quite well on low-fertility soils. Because succulent pasture on flight strips induces stock to concentrate on these areas, less palatable grasses and hard-wearing species should be sown. Seed mixtures must be compounded to suit conditions, and in most places browntop, chewings fescue, and yarrow should be sown with some ryegrass and crested dogstail.

The surface of the strip should contain a minimum of clover, and to offset this one or two applications of a nitrogenous fertiliser such as sulphate of ammonia may be necessary during the first year. A strong, dense turf will protect the surface against wear and erosion.

—*E. A. MADDEN,*
Agrostologist,
Department of Agriculture,
Palmerston North

[Advice about flight-strip construction may be sought from Mr. Madden through the Department's Instructors in Agriculture.—Editor.]

HEADING PHOTOGRAPH: Orderly and neat rows make garden operations much easier. Green and Hahn Photography Ltd. photo.

New Season in Home Garden Begins in August

By C. L. NAPIER, Horticultural Instructor, Department of Agriculture, Hastings

AUGUST can be regarded as the beginning of the new season in the vegetable garden, and most gardeners will be planning summer plantings. To be successful, planting must be carried out with the same care exercised with seed sowing. Practices such as rotation, successional planting, and catch cropping can all contribute to good garden management, and if adopted wisely, will assist in providing the maximum of produce from the garden plot available without tending to exhaust the soil of important plant foods.

THE planting season usually cannot be gone through without some vegetables such as cabbages, cauliflowers, silver beet, and leeks being transplanted. Transplanting is an important operation, and success depends on sturdy and healthy plants, good soil and climatic conditions, and efficient operations. Gardeners should avoid using poor plants or planting in unfavourable conditions where possible.

Garden Planning

Vegetable crops should not be sown or planted without some planning first. Plots should be planned so that the maximum of sunshine reaches every plant and row. This is particularly important in spring and autumn. Where possible, rows should run north and south so that each row receives the benefit of sunshine at some time during the day. If it is necessary to run rows east and west, it is best to put short plants on the northern side of the garden and vegetables such as corn, tall tomatoes, and climbing beans toward the south.

In large gardens, where a little shelter would no doubt be an asset, corn can be quite effective if grown in rows at intervals throughout the garden.

For ease of access and working, rows are best run at right angles to a path. Small-scale crops such as herbs, radishes, and perhaps lettuces should be planted where the housewife can reach them easily. Vegetables such as rhubarb and asparagus are best planted on one side of the garden so that they will not interfere with seasonal operations.

Where possible some form of crop rotation should be practised (see below), and when this is done gardeners should endeavour to choose those vegetables which do best in their locality. Selection of the most suitable varieties and kinds to give a continuous supply throughout the year should also be the aim.

Ridging and Hillside Gardening

For winter and early-spring crops or where soil conditions tend to be naturally wet and cold, ridges on which crops are to be grown can be constructed. In soils with high water-tables during the wetter months plants grown on ridges have a better chance of survival than those on the flat. Raised beds wide enough to take several rows achieve the same purpose and can be used for any type of crop. Soil in ridges tends to warm up more quickly in spring and for this advantage alone ridging is of value.

Hillside gardening offers particular problems. Excessive slopes probably will have to be terraced, but ridging may be sufficient on gentle slopes. Work will be made easier and erosion checked if all rows run round a slope and not down. Ridges tend to check excessive water run-off during winter and irrigation water can conveniently be run between them in summer.

Pricking Out

It is sometimes necessary to sow seed in boxes and frames for the reasons outlined in the home vegetable garden article in the June issue of the "Journal" (page 503). Resultant seedlings are often too dense to produce sturdy plants and pricking out (the transference of the small seedlings to other seed boxes to allow them more space in which to develop before planting in the garden) becomes necessary.

Pricking out should be done when seedlings are large enough to be handled, and if seedlings are given sufficient room, they should develop into sturdy plants with only one such treatment. In the past the practice has been to prick out many seedlings twice, but this has been questioned and experiments have shown that too many prickings out reduce the vitality and cropping power of the plants.

Some hours before pricking out is begun the soil should be moistened. Care in lifting is important, as the seedling roots are easily damaged. Useful implements for pricking out can be made from a small wooden label or a shoe-horn. The thinned-down, pointed end of the label acts as a small dibble and is large enough for pricking out small seedlings. The straightened, smaller end of a shoe-horn makes a more permanent dibble and can be sharpened a little if required. Pricked-out seedlings should be firmed in with the fingers and the soil watered to aid their establishment.

Crop Rotation

The rotation of crops in the home garden can be termed the growing of different types of crops in fairly regular order on a particular plot. There are several reasons for doing this. First, different kinds of vegetables use plant foods in different proportions, and if one particular type is planted in the same land for a number of years, one plant food may tend to become deficient. Another important reason is that rotation is a good means of controlling certain plant pests and diseases. For instance, club root of

SOWING AND PLANTING DATES FOR HOME VEGETABLE GARDENS IN NORTH ISLAND

Vegetable		Northland	Auckland	Tauranga	Pukekohe	Hamilton	Gisborne	Hastings	Manawatu	Wanganui	Wellington, Wairarapa
Asparagus ..	S P	Aug.-Oct. Aug.-Sep.	Aug.-Sep. July-Aug.	Aug.-Sep. July-Aug.	Aug.-Sep. Sep.-Oct.	Aug.-Sep. Aug.-Sep.	Oct.-Nov. July-Sep.	Sep. Aug.-Sep.	Sep.-Oct. Aug.-Sep.	Aug.-Oct. July-Sep.	Sep. Aug.
Beans:											
Dwarf ..	S	Sep.-Feb.	Oct.-Feb.	Oct.-Jan.	Aug.-Nov.	Oct.-Feb.	Oct.-Feb.	Oct.-Jan.	O. Sep.-Dec. P. Oct.-Dec.	Oct.-Jan.	Oct.-Nov.
Climbing ..	S	Oct.-Jan.	Oct.-Jan.	Oct.-Dec.	Sep.-Oct.	Oct.-Jan.	Oct.-Nov.	Oct.-Nov.	O. Sep.-Dec. P. Oct.-Nov.	Sep.-Nov.	Oct.-Nov.
Broad ..	S	May-Aug.	May-Aug.	May	Jun.-July	Apr.-May	May-Aug.	Apr.-May	O. Mar.-Jun. P. Mar.-May	Apr.-May Aug.-Sep.	Apr.-May, Sep.
Beet:											
Red	S	Oct.-Mar.	Sep.-Mar.	Sep.-Dec.	Aug.-Feb.	Sep.-Mar.	July-Apr.	Aug.-Feb.	O. May-Mar. P. Oct.-Mar.	Sep.-Dec.	Sep.-Mar.
Silver ..	S	All year	Sep.-Mar.	Sep.-Mar.	Sep.-Mar.	Sep.-Jan.	July-Mar.	Aug.-Mar.	O. All year P. All year	Sep.-Dec.	Sep.-Mar.
Broccoli ..	S P	Oct.-Jan. Dec.-Feb.	Oct. Dec.	Oct.-Nov. Dec.-Feb.	Oct. Dec.	Nov.-Dec. Jan.-Feb.	Nov.-Jan. Dec.-Feb.	Oct. Dec.-Jan.	Sep.-Jan. Nov.-Mar.	Oct.-Dec. Dec.-Feb.	Oct.-Dec. Dec.-Jan.
Brussels sprouts	S P	Oct.-Dec. Jan.-Mar.	Feb. Apr.-May	Oct.-Nov. Dec.-Feb.	Feb. Apr.-May	Nov. Jan.	Nov.-Dec. Dec.-Jan.	Oct. Dec.-Jan.	Oct.-Jan. Dec.-Feb.	Oct.-Nov. Dec.-Jan.	Oct.-Dec. Dec.-Jan.
Cabbage:											
Spring ..	S P	Feb.-Mar. Mar.-May	Feb.-Apr. Mar.-May	Jan.-Feb. Mar.-Apr.	Apr.-May Jun.-July	Mar. May	Jan.-Feb. Feb.-Apr.	Feb.-Mar. May-Jun.	Feb.-Apr. Mar.-Jun.	Feb.-Mar. Apr.-May	Feb. Mar.-Apr.
Summer ..	S P	May-Oct. Aug.-Nov.	Apr.-Jun. May-July	Jun.-July Aug.-Sep.	Aug.-Sep. Oct.-Nov.	July Sep.	Aug.-Sep. Sep.-Oct.	July Sep.-Oct.	Aug.-Sep. Nov.-Dec.	July-Aug. Sep.-Oct.	July Sep.
Winter ..	S P	Nov.-Dec. Jan.-Mar.	Jun.-Aug. July-Sep.	Oct.-Nov. Dec.-Jan.	Jan.-Feb. Mar.-Apr.	Oct.-Nov. Dec.-Feb.	Nov.-Dec. Dec.-Feb.	Oct. Dec.-Jan.	Oct.-Dec. Dec.-Feb.	Oct.-Nov. Dec.-Feb.	Oct.-Nov. Dec.
Cauliflower ..	S	July-Feb.	Jan.-Jun.	Oct.-Nov.	Jan.-Feb.	Jun.-July	Sep.-Nov.	Nov.-Feb./Mar.	Nov.-Mar.	Mar.-Apr. July-Sep.	Late Jun.-Dec.
	P	Aug.-Mar.	Mar.-Aug.	Dec.-Jan.	Apr.-July	Aug.-Jan.	Oct.-Dec.	Jan.-Apr./May	Dec.-Apr.	Apr.-May Aug.-Oct.	Jun.-July
Carrot	S	Aug.-Mar.	Oct.-Mar.	Sep.-Dec.	Jun.-Mar.	Aug.-Jan.	Aug.-Sep., Jan.	Sep., Dec.	Apr.-Feb.	Aug.-Jan.	Sep.-Jan.
Celery	S P	Oct.-Dec. Dec.-Mar.	Oct.-Dec. Dec.-Mar.	Sep. Dec.-Jan.	Oct.-Dec. Dec.-Mar.	Sep.-Oct. Dec.-Mar.	Aug.-Oct. Oct.-Dec.	Sep.-Oct. Nov.-Dec.	Sep.-Oct. Nov.-Jan.	Oct. Dec.-Feb.	Sept. Nov.-Dec.
Cucumber ..	S	Sep.-Dec.	Oct.-Nov.	Oct.-Dec.	Sep.-Nov.	Oct.	Oct.-Dec.	Oct.-Nov.	Oct.	Oct.-Nov.	Nov.-Dec.
Kumara ..	P	Oct.-Nov.	Oct.-Nov.	Nov.	Oct.-Dec.	Oct.-Nov.	Nov.-Dec.	Oct.	Mid-Oct.	Oct.-Nov.	Nov.
Leek	S P	Nov.-Jan. Jan.-Mar.	Sep.-Oct. Dec.-Jan.	Sep.-Oct. Dec.-Jan.	Jan.-Feb. Apr.-May	Oct.-Nov. Jan.	Oct.-Dec. Dec.-Feb.	Aug.-Oct. Dec.-Jan.	Oct.-Dec. Dec.-Feb.	Sep.-Nov. Dec.-Feb.	Aug.-Sep. Dec.
Lettuce ..	S P	Sep.-Mar. Oct.-Apr.	All year Jan.-Dec.	All year	Aug.-Feb. Sep.-Jan.	All year	July-Sep., Mar. July-Sep., Mar.	Aug.-Mar. Aug.-May	May-Feb. July-Feb.	Nearly all year	Aug.-Mar. Aug.-Apr.
Marrow ..	S	Oct.-Nov.	Oct.-Nov.	Oct.-Dec.	Oct.-Nov.	Oct.-Nov.	Sep.-Oct.	Oct.-Nov.	Oct.	Aug.-Nov.	Nov.-Dec.
Melons (all types)	S	Oct.-Nov.	Nov.	Oct.-Nov.	Nov.-Dec.	Oct.-Nov.	Oct.-Dec.	Oct.-Nov.	Oct.	Aug.-Nov.	Nov.-Dec.
Onions	S P	July-Sep. Oct.-Nov.	Apr.-Jun. Aug.-Sep.	Mar.-Apr. Aug.-Sep.	Mar.-Sep. June-Aug.	Apr.-May Sep.-Oct.	Mar., July-Aug. July, Sep.-Oct.	Mar., Aug. July-Sep.	Aug., Mar.-Apr. Oct.	Mar., Sep. Sep., Oct.	Mar. July-Aug.
Parsnip ..	S	Nov.-Jan.	July-Jan.	Sep.-Dec.	June-Feb.	Sep.-Jan.	July-Sep.	Sep., Dec.	Oct.-Mid-Jan.	Oct.-Dec.	Oct.-Nov.
Pea	S	Sep.-Feb.	Jun.-Nov.	July-Jan.	July-Jan.	Oct.-Jan.	Aug.-Oct.	Aug.-Dec.	May-Dec.	Aug.-Dec.	Aug.-Feb.
Pumpkin and squash ..	S	Oct.-Nov.	Oct.-Nov.	Oct.-Nov.	Oct.-Nov.	Oct.-Nov.	Oct.-Nov.	Oct.-Nov.	Oct.	Oct.-Nov.	Nov.-Dec.
Potato ..	P	Sep.-Nov.	Aug.-Feb.	Aug.-Dec.	May-Jan.	Oct.	Jun.-Sep.	Sep.-Oct.	Mid-Jun. Aug.-Oct.	July-Nov.	Sep.-Oct.
Rhubarb ..	P	Sep.-Nov.	July-Aug.	July-Aug.	Aug.-Sep.	Sep.-Oct.	Aug.-Sep.	Aug.-Sep.	Oct.	July-Sep.	July-Aug.
Swede	S	Dec.-Jan.	Sep.-Mar.	Dec.-Jan.	Sep.-Feb.	Nov.	Sep.	Sep.	Nov.-Jan.	Dec.-Feb.	Jan.
Shallot ..	P	Aug.-Nov.	Jun.-July	Aug.	Jun.-July	Aug.	Jun.	May-Aug.	July	May-Jun.	Aug.
Spinach ..	S	Sep.-Apr.	Jan.-Dec.	Oct.-Nov.	Jan.-Dec.	Feb.-Mar.	July-Sep.	Apr.-Sep.	Apr.-Jun.	Feb.-Mar. Aug.-Oct.	July-Oct. Mar.-Apr.
Sweet corn ..	S	Oct.-Dec.	Oct.-Dec.	Oct.-Nov.	Oct.-Dec.	Oct.-Nov.	Oct.-Dec.	Oct.-Nov.	Oct.-Dec.	Nov.-Dec.	Oct.-Nov.
Tomato ..	P	Oct.-Dec.	Oct.-Dec.	Oct.-Dec.	Sep.-Jan.	Oct.-Jan.	Jun., Sep.-Oct.	Oct.-Nov.	Oct.-Jan.	Oct.-Dec.	Oct.-Jan.
Turnip	S	Sep.-Feb.	Jan.-Dec.	Sep.-Mar.	Sep.-Dec.	Nov.-Mar.	Aug.-Sep.	Aug.-Sep.	Sep.-Feb.	Sep.-Jan.	Aug.-Oct. Feb.-Mar.

Second column: S, sowing dates; P, planting dates. Manawatu column: O., Otaki district; P., Palmerston North district.

SOWING AND PLANTING DATES FOR HOME GARDENS IN SOUTH ISLAND

Vegetable		Nelson	Blenheim	Christchurch	North Otago, South Canterbury	Dunedin	Southland
Asparagus	S P	Sep. Aug.	Sep. Aug.	Aug.-Sep. July-Sep.	Oct. Aug.	Oct.-Nov. Aug.-Nov.	N.G.
Beans:							
Dwarf	S	Oct.-Jan.	Late Oct.	Oct.-Nov.	Oct.-Nov.	Oct.-Nov.	Oct.
Climbing	S	Oct.-Nov.	Late Oct.	Oct.-Nov.	Oct.-Nov.	Oct.-Nov.	Oct.
Broad	S	Mar.-May	Apr.-Sep.	Apr.-Sep.	May, Aug.	Mar.-Jun.	Mar., Sep.-Oct.
Beet:							
Red	S	Sep.-Feb.	Aug.-Feb.	Aug.-Jan.	Aug.-Feb.	Oct.-Jan.	Oct.
Silver	S	Mar.	Aug.-Feb.	Aug.-Mar.	Aug.-Feb.	Sep.-Jan.	Sep.-Feb.
Broccoli	S P	Nov. Jan.-Feb.	Oct.-Nov. Jan.	Sep.-Nov. Oct.-Dec.	Oct. Dec.-Jan.	Sep.-Nov. Dec.-Feb.	Oct.-Nov. Dec.-Jan.
Brussels sprouts	S P	Nov. Jan.-Feb.	Oct.-Nov. Jan.	Sep.-Dec. Oct.-Jan.	Oct. Dec.-Jan.	Sep.-Nov. Nov.-Feb.	Oct.-Nov. Dec.-Feb.
Cabbage:							
Spring	S P	Feb.-Apr. Feb.-Apr.	Early Feb. Early Apr.	Jan.-Mar. Feb.-Apr.	Mar. Apr.-May	Jan.-Feb. Mar.-May	Jan.-Mar. Apr.-Oct.
Summer	S P	Aug.-Sep. Sep.-Dec.	Aug.-Oct. Sep.-Jan.	Aug.-Oct. Sep.-Nov.	Aug. Sep.-Oct.	Aug.-Oct. Oct.-Dec.	Aug.-Nov. Sep.-Jan.
Winter	S P	Nov. Jan.-Feb.	Oct.-Dec. Jan.-Feb.	Oct.-Dec. Nov.-Jan.	Nov.-Dec. Dec.-Feb.	Oct.-Nov. Dec.-Jan.	Oct.-Dec. Dec.-Feb.
Cauliflower	S P	Sep. Oct.	Aug.-Sep. Sep.-Oct.	Sep.-Nov. Nov.-Jan.	Aug.-Sep. Oct.-Jan.	Aug.-Oct. Oct.-Feb.	Aug.-Sep. Aug.-Jan.
Carrot	S	Aug.-Feb.	Aug.-Jan.	Aug.-Jan.	Aug.-Dec.	Sep.-Jan.	Sep.-Nov.
Celery	S P	Oct.-Nov. Jan.-Feb.	Nov. Jan.-Feb.	Oct.-Dec. Nov.-Feb.	Sep. Nov.-Dec.	Sep.-Nov. Dec.-Jan.	Sep. Dec.-Jan.
Cucumber	S	Oct.-Nov.	Oct.-Nov.	Sep.-Nov.	Sep.	N.G.	Oct.-Nov. under glass
Leek	S P	Oct. Dec.-Jan.	Aug.-Sep. Dec.-Jan.	Aug.-Oct. Nov.-Jan.	Oct. Dec.	Aug.-Sep. Dec.-Feb.	Sep.-Oct. Jan.-Feb.
Lettuce	S P	All year	Aug.-Apr. Aug.-May	Aug.-Mar. Aug.-Apr.	Aug.-Apr. Aug.-Apr.	Sep.-Feb. Aug., Feb.-Mar.	Jun.-Jan. July-Feb.
Marrow	S	Oct.	Oct.	Sep.-Oct.	Sep.-Oct.	Oct.-Dec.	Nov.
Melons (all types) ..	S	N.G.	Late Oct.	N.G.	N.G.	N.G.	N.G.
Onions	S P	Mar.-Apr. Sep.-Oct.	Apr., Sep. Oct.	Aug.-Oct. Aug.-Sep.	Aug.-Sep. Sep.-Oct.	Sep.-Nov. Aug.-Oct.	Mar. Sep.-Nov.
Parsnip	S	Sep.-Dec.	Sep.	Sep.-Dec.	Aug.	Sep., Nov.-Dec.	Oct.-Nov.
Pea	S	Aug.-Jan.	Aug.-Jan.	May, Sep., Jan.	Apr., Aug.-Dec.	Sep.-Jan.	Aug.-Jan.
Pumpkin and squash ..	S	Oct.	Late Oct.	Sep.-Oct.	Sep.-Oct.	Oct.-Dec.	Nov.
Potato	P	Aug.-Oct.	Aug.	July-Nov.	Aug.-Oct.	Aug.-Dec.	July-Jan.
Rhubarb	P	Apr.-May	July-Aug.	Aug.-Oct.	May-Aug.	Jun.-Sep.	Sep.
Swede	S	Dec.-Jan.	Dec.-Jan.	Nov.-Jan.	Aug.-Dec.	Oct.-Dec.	Oct.-Nov.
Shallot	P	Apr.-Sep.	Jun.	Jun.-July	Aug.	Jun.-Sep.	Sep.
Spinach	S	Oct.-Feb.	Aug.-Sep. Feb.-Mar.	Aug.-Oct. Mar.-Apr.	Aug.-Feb.	Aug.-Oct. Feb.-May	Sep.-Feb.
Sweet corn	S	Oct.	Late Oct.	Oct.-Nov.	Sep. under glass	N.G.	N.G.
Tomato	P	Oct.	Early Nov.	Oct.-Nov.	Mid-July-mid-Jan.	Oct.-Dec.	N.G.
Turnip	S	Oct.-Jan.	Sept.	Aug.-Oct.	Aug.-Oct.	Aug.-Oct. Jan.-Apr.	Sep.-Nov.

Second column: S, sowing dates; P, planting dates. N.G.: Vegetable not grown extensively or conditions not satisfactory for general culture in district.

brassica crops can be controlled by keeping the affected land free of these crops for 3 or 4 years.

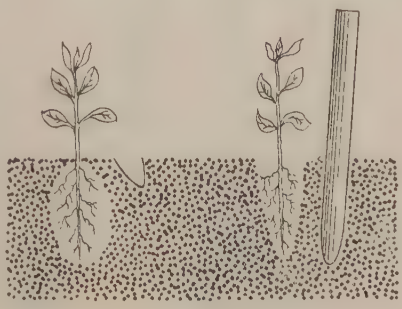
Rotation can follow two broad systems: In the first the vegetables are in three main groups comprising fibrous-rooted, tuberous-rooted, and taprooted vegetables. In the second there are four groups covering taprooted vegetables, fibrous-rooted or leaf crops, tubers, and legumes. Examples of the first system are shown in the following table:—

Crop 1	Crop 2	Crop 3
Cabbages	Potatoes	Carrots
Onions	Peas	Spinach
Leeks	Beans	Parsnips

Examples of the second system are:—

Crop 1	Crop 2	Crop 3	Crop 4
Beetroot	Lettuces	Beans	Potatoes
Carrots	Cabbages	Peas	Potatoes

If crop rotation should be practised, it must not replace the maintaining of soil fertility by applying organic matter and other manures. It should be noted also that gardens must be divided into plots coinciding with the number of groups in the system gardeners adopt.

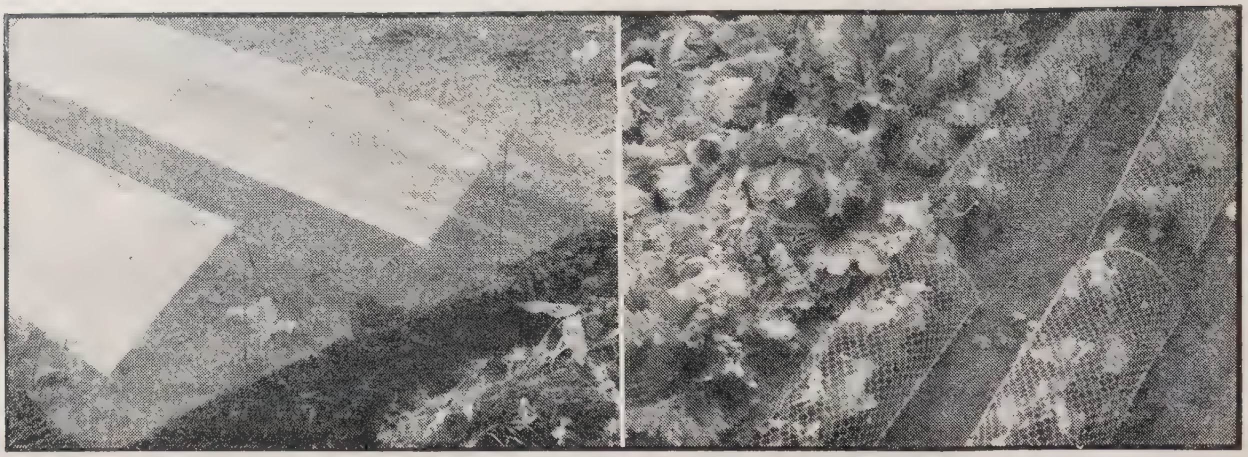


If a dibble is used for heeling in plants, it should not be used in such a way that an air pocket is created (left). The correct position for the dibble is shown at right.

Transplanting

Transplanting of seedlings in the open from boxes or seed-beds should take place as soon as the seedlings are large enough, providing all other conditions are satisfactory. If raised under glass or in hot-beds, seedlings may be rather soft and should be hardened off before being planted outside. If plants are left too long in their boxes or seed-beds, they tend to become soft and drawn because of their proximity to each other and competition for the food available.

The best time to transplant is during overcast and cool weather or just



[*Photos by Sparrow Industrial Pictures Ltd. (left) and Green and Hahn Photography Ltd. (right).*
Left—Barn-type cloches are valuable for early crops such as lettuces, cucurbits, and peas. Right—Second crop in successional planting of lettuces protected from birds by wire guards, which are permanent and can be used for many crops.

before or after rain. In the evening is also satisfactory, and plants then have an opportunity to recuperate partially during the night.

Removal of Foliage

The removal of portion of onion, leek, and brassica foliage before transplanting is common, but the value of the practice is still questionable. The belief is that the removal of foliage reduces transpiration, thus assisting plants to recover quickly from the shock of moving. However, the direct water loss from injured leaves may be greater than from uncut leaves. Furthermore, the leaves carry on photosynthesis, which provides carbohydrates for growth, including the formation of new roots. Reduction in leaf surface therefore checks new root development and the quick recovery of plants.

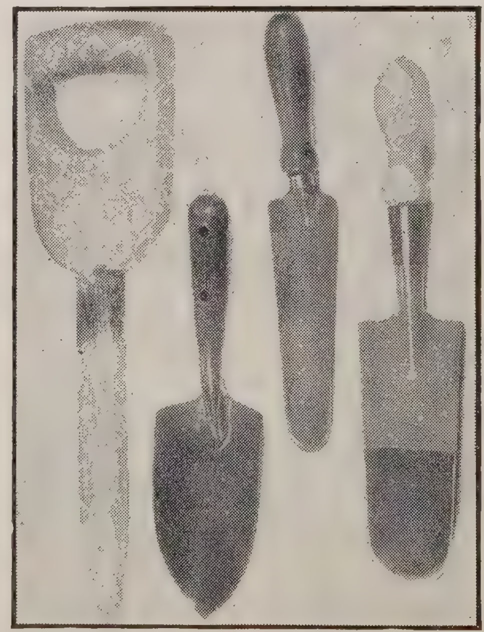
Overseas trials have proved that onions transplanted with whole foliage give better and larger crops than those with portion of the foliage removed.

What to Transplant

All vegetables make better growth if they are sown where they are expected to grow. However, for the reasons given in last month's article (page 503) seed-bed raising is often necessary and more convenient. Not all vegetables are suited to transplanting, as some, such as the root crops, tend to run to seed if growth is checked. Cabbages, cauliflowers, silver beet, lettuces, brussels sprouts, onions, leeks, and celery are the vegetables which appear to do best if transplanted. Root crops generally are not successful, but if handled carefully, beetroot produces quite good crops. Cucurbits, such as pumpkins, marrows, and cucumbers, do best if sown in their permanent positions; they should be raised in pots if they are to be transplanted, so that the check to their roots is as slight as possible. Cucurbits are very tender plants and do not stand rough treatment such as lack of moisture or damage to their root system.

How to Transplant

The subsequent crop depends to a large degree on the thoroughness of transplanting. A careless job results in a poor strike, weak plants, and possibly a reduced crop. Some hours before transplanting begins seedlings in beds or boxes should be watered thoroughly if necessary. The plot to be planted should be prepared before lifting of seedlings takes place, so that drying out of roots is less likely to occur. The soil should be prepared as suggested in the May issue of the "Journal" to give any organic matter time to rot down. At the time of planting the soil should be firm and the normal packing given while preparation takes place is usually sufficient.



[*R. W. Orr photo.*
Left—Garden dibble made from a broken spade handle. The centre trowel of the three shown is very suitable for most plantings.

Seedlings sown in seed boxes should be lifted carefully and with as much soil as possible about their roots. This reduces root damage to a minimum. Seedlings in seed-beds are usually much closer together than those in boxes and require careful lifting so that adjacent plants to be lifted are not damaged. The most advanced seedlings of a uniform stage of growth should be taken for each planting. Poor plants, those with blind growing points, twisted stems, or weak root systems, and brassicas with any evidence of club root should be rejected.

There are many transplanting tools, but the four shown below are suitable for the purpose. The dibble (at left) is very suitable for leeks planted in the bottoms of holes. This method is quite satisfactory, as the natural sifting in of soil from the rims of the holes, particularly if plants are watered in, is sufficient to cover the roots. The left- and right-hand trowels illustrated are satisfactory for fibrous-rooted plants such as celery or well-grown brassicas. The middle trowel, which is much narrower, is very handy for general planting where roots tend to be long and narrow.

For good results the depth of planting must be watched carefully. With crops such as celery and onions incorrect depths can affect development seriously. The following are suggestions for the main vegetables transplanted:—

Brassicas should be transplanted at slightly greater depth than they were in the seed-bed. The growing point may be buried if they are too deep, and if planting is too shallow plants may be top-heavy and the roots may dry out. These points apply to other kinds of vegetables.

Lettuces, silver beet, beetroot, celery, onions: All these vegetables should be planted at the same depth as they were in the seed-bed, except onions, which, if planted too deeply, will not form

[*R. W. Orr photo.*
Catch cropping. Here winter leeks have been planted between autumn lettuces.

bulbs. These plants are best set out with only the roots in the soil, but if this is not possible, a very short length of stem should be covered.

It is particularly important with lettuces and celery to keep the young growing point above the soil surface.

Leeks can be set out with portions of the stems in the soil, if they are being grown in trenches. If the plants are being dropped into dibble holes, no more attention should be required as long as the tips of the leaves are above ground.

Cucurbits must be transplanted with care and with as much soil as possible about the roots. The plants can be set slightly deeper than when growing as seedlings.

All holes made to receive seedling vegetables should be large enough to take the roots without bunching them or curling them up. If a trowel is used, the full length plunged into the soil and drawn toward the gardener will make a hole suitable for most types of roots. Within reason, the deeper roots are, particularly during summer, the better they can withstand dry conditions. Firming of the soil about seedlings (heeling in) is very important and it has been shown in commercial crops that good heeling in gives a better start to plants and subsequently a healthier crop. When a dibble or trowel is used to draw soil about the roots of the plants care should be taken not to leave an air pocket below the surface. The diagram on page 67 illustrates this point. Heeling in when the soil is wet should be done judiciously and in all cases must not be done so firmly that the seedlings are drawn too deeply into the soil. If necessary, plants should be watered thoroughly after setting out.

The question of when to transplant is always a problem for gardeners, as temperatures, frosts, excessive rain, or lack of rain are all limiting factors. No definite recommendations can be made for New Zealand as a whole, but the tables on pages 66 and 67 should be a guide. Both sowing and planting dates are given for the main centres or a district generally. The dates have been provided by officers of the Department of Agriculture in the various centres. Gardeners should base their sowing and planting schedules on these dates, according to their own local conditions, but if in doubt should ask for advice. The dates given are those that have been found the most satisfactory in the districts named, but no doube in particular localities plant- no doubt in particular localities plantdelayed or advanced.

Succession and Catch Cropping

In garden plots where space is limited or in districts with short seasons, succession cropping may have some value. Succession cropping means the growing of two or more quick-maturing crops on the one plot in the same year. As an example, after early peas beans can be planted and then autumn cabbages. Quick-maturing crops make this system a success.

Catch cropping or interplanting is the planting of one kind of vegetable between another. Two methods can be used: Radishes and lettuces (for example) can be planted between later-maturing celery or leeks. Leeks can be planted between summer lettuces. In confined areas catch cropping may be advantageous, but gardeners should bear in mind that the more-intensive cropping may require a heavier manurial programme.

Maintenance Work

Thinning: Some early crops will soon need thinning to give the plants more room to develop. Thinning should be done carefully and where possible in cool weather so that the least damage is done to the remaining plants. If the soil is dry, it should be watered thoroughly before thinning begins, as this will tend to soften the soil. All weak and diseased seedlings should be removed and only the healthiest left. Thinnings of plants that can be transplanted with success, say lettuces or beetroot, can be set out to mature. These plants usually come in a week or two after the original sowing, and thus the maturing period for this particular sowing is extended. Crops such as carrots, if sown thinly, need no thinning until the most advanced are large enough to use. The remaining plants are given more room to develop and there is no waste.

Sowings

The following may be sown in August:—

Asparagus, in drills ½in. deep. Thinning later to 4in. apart gives better plants, which can be planted in 12 months' time; Mary Washington and Paradise are good varieties.

Carrot: Seed of the early varieties such as Guerande and Early Crop for early-summer use can be sown. Raised beds are preferable in less favourable localities.

Cauliflower: Seed to give a continuity of supply during summer and autumn; varieties such as Early London, Phenomenal (5 months), and Phenomenal Main Crop will provide this.

Cabbage: Seed of summer varieties such as Golden Acre, Copenhagen Market, and Henderson's Succession to give steady summer and autumn supplies.

Beetroot such as Early Wonder, Derwent Globe, and Detroit Dark Red as thinly as possible.

Plantings

The following may be planted in August:—

Asparagus of the varieties previously mentioned. Sturdy 1-year plants are best and should be set 8in. deep and 18in. apart in the rows.

Cabbage and cauliflower of early-summer varieties in northern districts.

Onions in the northern districts. Ailsa Craig and Giant Rocca are suitable for early use and Pukekohe Long Keeper and Brown Spanish for the main crop.

Potatoes of Epicure and Arran Banner varieties in the most favoured districts. Tubers should not be set too deeply; 3 to 4in. is sufficient.

Additional Sowings and Plantings

Sowings of the following can also be made: Globe artichoke, kohl rabi (White or Purple Vienna), lettuce (Imperial 615 or Tom Thumb, a dwarf), onions (late-maturing varieties, in situ), parsley (curled types), radish (French Breakfast, White Icicle), spinach (prickly seeded), turnips (White Stone, Snowball), and peas (William Massey, Little Marvel).

Garlic, lettuce, rhubarb, shallots, thyme, and sage can all be set out where soil conditions are satisfactory, but caution is still required in southern districts.

Other Work

Kumara tubers can be set in hot-beds to produce plants for setting out later. All old beds should be cleaned up and remaining root crops lifted before they show signs of regrowth. Stored crops should be checked over for rots. Cover crops should be dug in and the garden given a general cleaning up, if it was impossible to do this during winter.

Health Aspects of Plant Therapeutants

By H. JACKS, Plant Diseases Division, Department of Scientific and Industrial Research, Auckland

SUBSTANCES used in plant protection have adverse effects on the living cells of bacteria, fungi, nematodes, and insects which are responsible for plant damage. Such chemicals may be expected to be potentially dangerous to the cells of the human beings who handle them or who consume treated produce. It is well known that certain plant therapeutants are toxic both to man and animals, but little is known of possible toxic effects of the many new substances recently introduced. These new materials in their various formulations as sprays (wettable powders, pastes, and emulsions), dust, and fumigants have already been described (Jacks 1951, 1952).

LEHMAN and others (1949) drew up a schedule giving the information required about any substance to evaluate its toxicity to man and animals. This schedule, which is outlined briefly below, has been used by most overseas workers investigating toxicity of plant therapeutants.

Information Required to Assess Toxicity of Plant Therapeutants

1. Solubility in water, oils, fats, and physiological fluids, composition, stability, and purity of a product, and quantitative detection in micro amounts giving accurate identification and measurement of toxic substances in tissues of affected organs.

2. Acute toxicity: Average oral lethal dose (LD-50, that is, amount of a substance in grammes per kilogram of body weight which is expected to kill one half of a group of animals under test) studies on several species of animals, one of which should not be a rodent.

3. Sub-acute toxicity (2 to 4 months feeding): (a) On rodents at several levels in the diet in which the lowest amount should be 10 times the level encountered on food and the highest the maximum intake the animal can tolerate. (b) On dogs at levels slightly lower than for (a).

4. Chronic toxicity: 1. On rodents for 2 years at levels 100 times higher than those encountered on food, to accentuate physiological effects, and increasing to the highest tolerated amounts. 2. On dogs or monkeys for at least 6 months at low levels producing no effects, at intermediate levels, and at high levels approaching the tolerated dose.

5. Reproduction studies.

6. Biochemical studies comprising absorption, distribution, and excretion, detoxification and fate of the material in the body, urine and blood analyses, organ function tests, and studies on enzymes.

7. Pathological observations such as gross and microscopic examination of organs and tissues and observations of unusual effects or sensitivity of human subjects (Lehman 1951).

Research of this type has not been carried out in New Zealand, the information that follows having been taken from the work of reliable overseas investigators. Investigations in New Zealand have been concerned mainly with two aspects: The search for reliable chemical methods to estimate the amount of chemical residues on plant produce and the study of the rate of breakdown of these residues so that spray programmes may be timed to reduce the residual amounts of toxic materials.

Health Hazards

Absorption of plant therapeutants presenting health hazards may occur through exposed parts of the skin, by inhalation, and by ingestion. Whereas exposure to materials of acute toxicity, such as nicotine sulphate and phosphate insecticides, may bring about almost immediate effects, the deposition and accumulation of less toxic residues in the body may not be observed for a considerable time. The following examples are given to illustrate the toxic effect of excessive exposure of the body to certain chemicals:—

Substances such as nicotine sulphate, arsenic, the chlorinated hydrocarbons, D.N.O.C., organic phosphorus compounds, and methyl bromide, may cause gastro-enteritis, pains in the joints, headaches, giddiness, insomnia, loss of weight, palpitations, general depression, and degeneration of the nervous system. The lungs may be overstimulated and oedema may result from prolonged exposure to phosphorus compounds and fumigants such as cyanide, methyl bromide, ethylene dibromide or dichloride, chloropicrin, D-D, etc. Similarly, arsenic, D.D.T., B.H.C., chlordane, chlorinated camphene and other chlorinated hydrocarbons, phosphorus insecticides, selenium, and fumigants such as carbon tetrachloride may affect the liver. Overstimulation of the heart by D.D.T., chlordane, and fluoroacetate has been reported. Degeneration of the kidneys may be caused by the presence of excessive amounts of arsenic, D.D.T., B.H.C., methoxychlor, carbon tetrachloride, phenols, and

HEADING PHOTOGRAPH: Tractor pulling row-crop sprayer equipped with air-conditioned cab to protect operator. Photo supplied by Pest Control Ltd., England.

mercury compounds. The muscles may be overstimulated by organic phosphorus compounds and D.N.O.C. (Anon., 1951; Hine, 1949). Many other instances of after effects from excessive exposure to plant therapeutants could be cited.

Operator of a seed-dressing apparatus wearing dust mask for protection against harmful particles.

TOXIC EFFECTS

The toxic effects of some materials used in plant protection are as follows:—

Seed Disinfectants

Fungicidal treatments using organic mercury compounds, quinones, carbamates, polychlorobenzenes, etc., with or without addition of insecticides, present no consumer hazards from food grown from treated seeds. Seeds are, however, unfit for consumption once treated. Since organic mercury compounds are poisonous and the other listed materials may cause irritation of nose and throat, operators exposed to hazards of inhalation of dust particles or fumes should use face pads or masks (see the illustration on this page). Quinones and carbamates may cause skin irritation; therefore persons susceptible to dermatitis should apply a protective ointment to exposed parts of the skin before commencing seed-treatment operations.

Soil Disinfectants and Fumigants

Fumes of soil disinfectants such as formaldehyde and various phenolic compounds have a penetrating odour and irritate the nose and throat and their concentrates may cause injury to exposed parts of the skin. Natural rubber gloves should be worn to protect the hands. Fumigants such as chloropicrin, dichloropropene plus dichloropropane (D-D), chlorobromopropene, ethylene dibromide, and dichloride, etc., vaporise into pungent gases which are toxic. Even more dangerous than the foregoing is methyl bromide, which in addition to being highly toxic is odourless. Operators should protect themselves by using respirators (see the illustration on page 78). Spilling of the liquids on skin and clothing must be avoided and in case of accident affected parts should be washed immediately with soap and running water. Clothing on which liquids have been spilt should be removed immediately. Use of soil fumigants and disinfectants does not bring about hazards to consumers of produce grown in treated soils.

Warehouse Fumigants

Materials such as hydrogen cyanide, chloropicrin, methyl bromide, used for fumigation of warehouses, silos, or flour mills, are poisonous to operators. Respirators should be worn by operators when they are preparing for fumigation and they should avoid spilling liquids over skin and clothing. Warning signs must be posted to keep out unauthorised persons; signs should be removed only when no trace of fumigant is detected after ventilation of treated premises. Operators entering premises treated with methyl bromide must wear respirators and use halogen detection apparatus for discovery of traces of this insidious gas. Under normal conditions of use there is no residue problem and no hazard to consumers of treated produce.

Precautions with Plant Therapeutants

Precautions recommended in this article may be summarised as follows:—

1. Store materials in a dry, cool, and well-ventilated room. Make sure containers are tightly closed and properly labelled.
2. Store materials out of reach of children and animals.
3. Avoid spilling materials when measuring out and when charging sprayers and dusters. Clean up any spillage at once.
4. Defective containers should be handled with hands protected by natural rubber gloves to guard against absorption through the skin.
5. Chemicals spilt on the skin should be washed off immediately with soap and water. Clothing on which any material has been spilt should be removed and operators should wash with soap and water before changing. Drops or particles in the eye should be removed by flushing with large quantities of water.
6. Avoid contact of materials with mouth.
7. Always use eyeshields when spraying or dusting. Protective clothing and respirators should be worn when applying phosphate insecticides.
8. Avoid eating, drinking, or smoking during spraying operations and on or in the neighbourhood of the spraying area.
9. Allow adequate time between application and crop harvest to minimise residues.
10. Avoid spraying in windy weather to prevent damage to vegetation, people, and animals in the vicinity of operations.
11. Leave the spraying area if headaches, blurred vision, giddiness, palpitations, or tightness in the chest develop.
12. Prompt treatment is vital in most cases of poisoning and medical aid should be sought at once.
13. Dispose of unused material in the sprayer by discharging it in a safe place, for example, a hole in the ground filled after emptying the sprayer.

Fungicides

The following substances are not toxic to warm-blooded animals:—

Fillers, for example, various clay products, talc, kaolin, diatomaceous earth, pyrophyllite, Fuller's earth, silica, and gypsum; precautions, however, should be taken against inhalation of fine dusts containing free silica (silicon dioxide).

Certain substances used in specific combinations, for example, magnesium carbonate, magnesium sulphate, soaps, and hydrated lime.

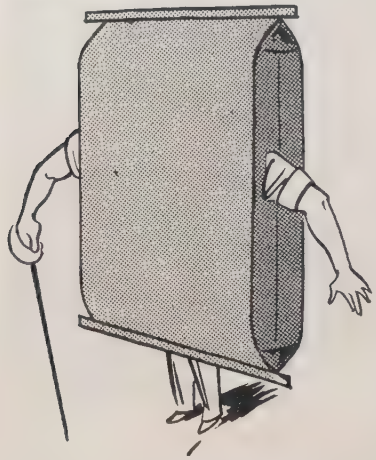
Plant therapeutants, for example, calcium carbonate, calcium phosphate, elemental sulphur, wettable sulphur, colloidal sulphur and dusting sulphurs (Anon., 1951).

Certain compounds are deleterious to health only if ingested in large doses. The following materials present no health hazards, but should be stored out of reach of children:—

Copper compounds, for example, copper

I CUT THE

LABOUR



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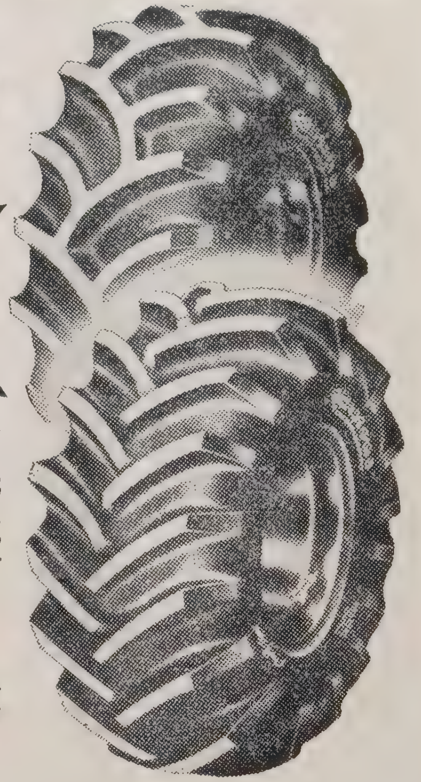

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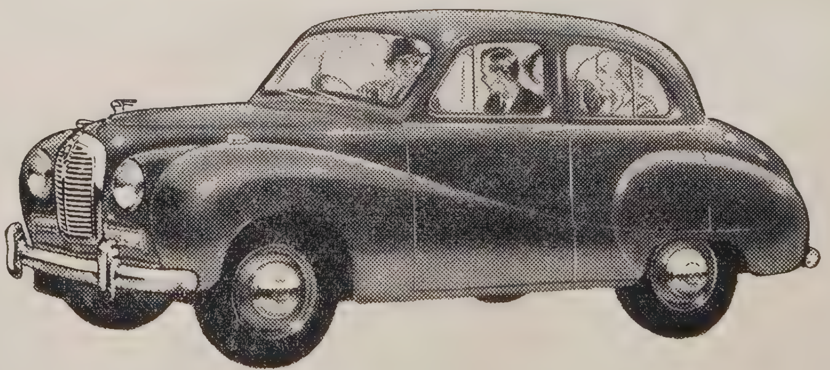

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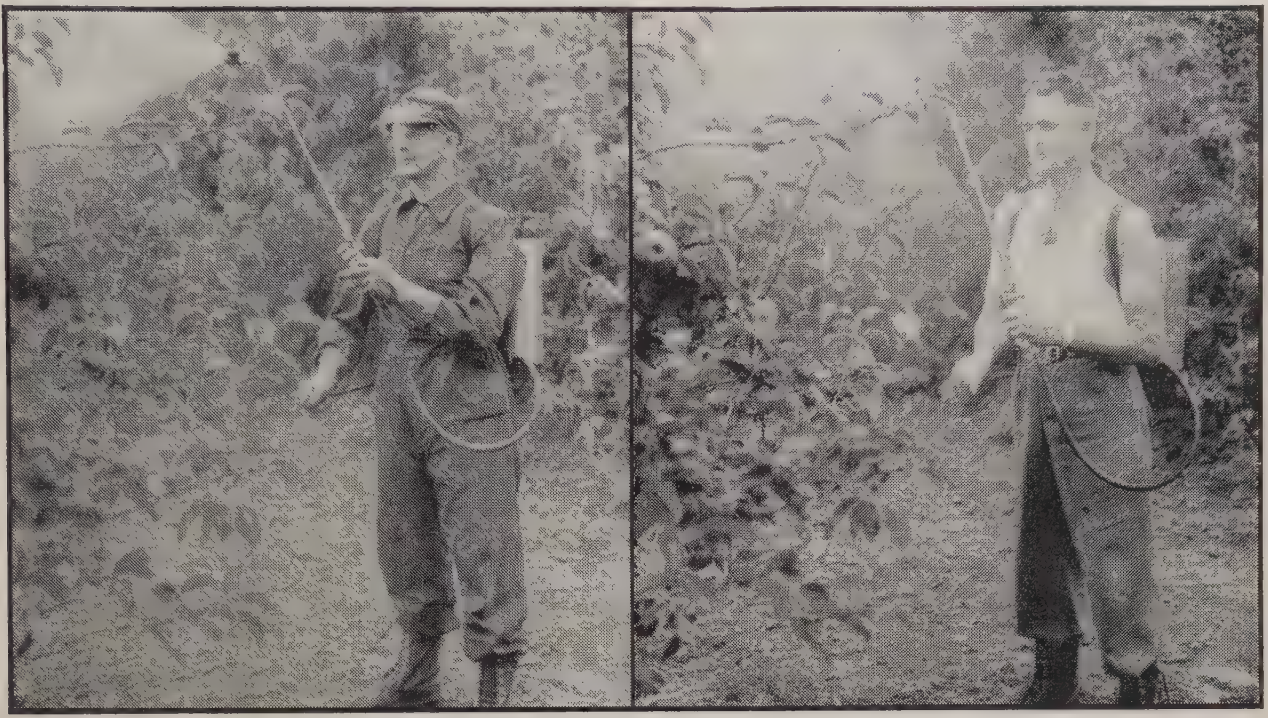

Knapsack spraying. Left—Wearing of eye shields and protective clothing is essential; as an additional precaution the wearing of respirators is recommended. Right—Unnecessary exposure to risks from skin and respiratory absorption of spray mists.

sulphate, copper zeolite, copper oxychloride, copper carbonate, cuprous oxide, copper phosphate, and copper silicate.

Dithiocarbamates (for example, ferbam, thiram, ziram, zineb, and nabam) resemble copper compounds in their toxicity, but they may cause irritation of the skin and respiratory tract. A face pad or dust mask should be worn when preparing spray mixtures and persons susceptible to dermatitis should apply protective ointment to exposed parts of the skin when handling these materials.

Zinc compounds, for example, zinc oxide and zinc sulphate: The same precautions as given for dithiocarbamates should be observed.

Quinones, for example, dichloronaphthoquinone ("Phygon") and tetrachloro parabenzoquinone ("Spergon") are relatively safe materials, but precautions as given for dithiocarbamates should be observed.

Phthalimide (SR-406) and **glyoxalidine** are also relatively safe materials, but may cause skin irritation (Anon., 1951).

Organo-mercury Compounds

Organo-mercury compounds are poisons, and if spray applications are not judiciously timed, residue hazards are a definite possibility. On fruit trees applications later than petal fall are not recommended and tolerances, if established, should not exceed medicinal doses. Consumption of produce bearing mercury residues may cause storage of mercury in the kidneys and subsequent renal damage at a mercury level of 0.5 p.p.m. (parts per million) (Anon., 1951). The rate of storage shows considerable variation with different formulations; for example, phenyl mercuric acetate causes from 10 to 20 times as much storage of mercury in liver and kidney tissue as mercuric acetate (Fitzhugh and others, 1950; Prickett and others, 1950).

Ingestion of mercuric chloride in single doses of 1 gm. could be fatal (Frear, 1950). The following precautions must be observed for both spray materials and seed dusts based on mercury:—

Avoidance of inhalation of dust and spray drift.

Removal of skin contamination with soap and water.

Safe storage.

Careful labelling.

Dinitro Compounds

Dinitro compounds, of which dinitro-orthocresol (D.N.O.C.) is the best known, are used as fungicides, insecticides and weedicides. They are dangerous poisons which must be handled with great caution. If dinitro compounds are used in the winter months as ovicides, the hazards are not so great as when the materials are applied during warm weather. Risks in spraying operations are from skin absorption during handling of concentrates and from inhalation of spray drift. Symptoms are:—

Early: Insomnia, sweating, lassitude, thirst, nausea, loss in weight, yellow discoloration of sclera, and greenish discoloration of urine.

Late: Marked sweating, thirst, respiratory distress, restlessness, muscle cramps, etc.

Affected persons should be given the following treatment:—

1. Treat at nearest shelter.
2. Apply sedative (for example, phenobarbitone 2 grains) to relieve anxiety.
3. Apply oxygen.
4. Frequent cold sponging to reduce temperature.
5. Glucose drinks with sodium chloride frequently.
6. In cases of ingestion induce vomiting; wash the stomach with 5 per cent. sodium bicarbonate solution and give 5 to 10 charcoal tablets, and 10 millilitres of 2.5 per cent. solution of sodium methyl thiouracil intravenously (David, 1951).

Insecticides

The insecticides lime sulphur and petroleum oils (summer and winter) are comparatively harmless. Although skin and eye irritation may sometimes occur, this can be prevented by wearing eyeshields and applying protective ointment to exposed parts of the skin.

Insecticides from Vegetable Sources

Rotenone, the active ingredient of derris, is not absorbed by the skin, but upon ingestion may affect respiration without harming the cardiovascular system. Inhalation of finely powdered rotenone may bring about symptoms of poisoning. The upper limit of tolerance for man is about 5 p.p.m. of

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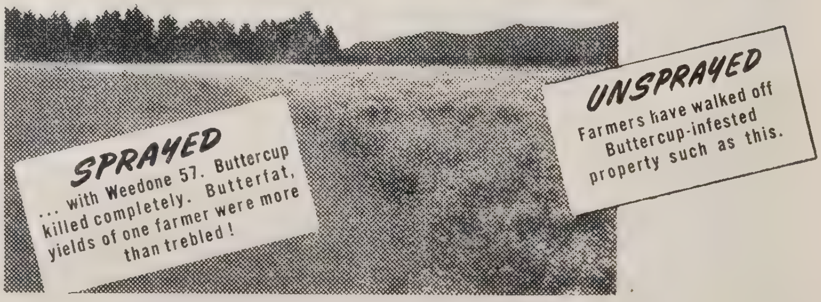
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rotenone in a diet consisting wholly of contaminated food. Rotenone acts as a gastric irritant and stimulates the emetic centre; swallowed material is thus removed before serious poisoning occurs. No specific antidotes are known and treatment must be symptomatic (Lehman, 1949).

Pyrethrins are not skin irritant in action, but may bring about respiratory paralysis upon ingestion. Allergic reactions and dermatitis may sometimes occur, but generally poisoning from a solution containing pyrethrins would be caused mainly by the solvents employed. Lavage (cleansing of the stomach by emetics administered in large quantities of water) is recommended in case of accidents (Lehman, 1949).

Nicotine sulphate is absorbed by the skin. Clothing on which it is spilt should be removed immediately and any skin contaminated should be washed with soap and running water. Clothing should be washed thoroughly before it is worn again. Nicotine is one of the most rapid and deadly poisons. Symptoms of a burning sensation in the alimentary tract are followed by salivation, nausea, vomiting, muscular weakness, and finally convulsion and paralysis of the respiratory muscles (Lehman, 1949). Workers must avoid contamination of skin, eyes, and clothes and wear a respirator. Treatment consists of artificial respiration and the use of respiratory stimulants (David, 1951).

Sabadilla is extracted from seeds of the genus *Schoenocaulon* (Mexico). These seeds contain a complex group of alkaloids and precautions must be taken against inhalation of powders. Little is known about the toxicity of sabadilla to warm-blooded animals.

Metallic Compounds

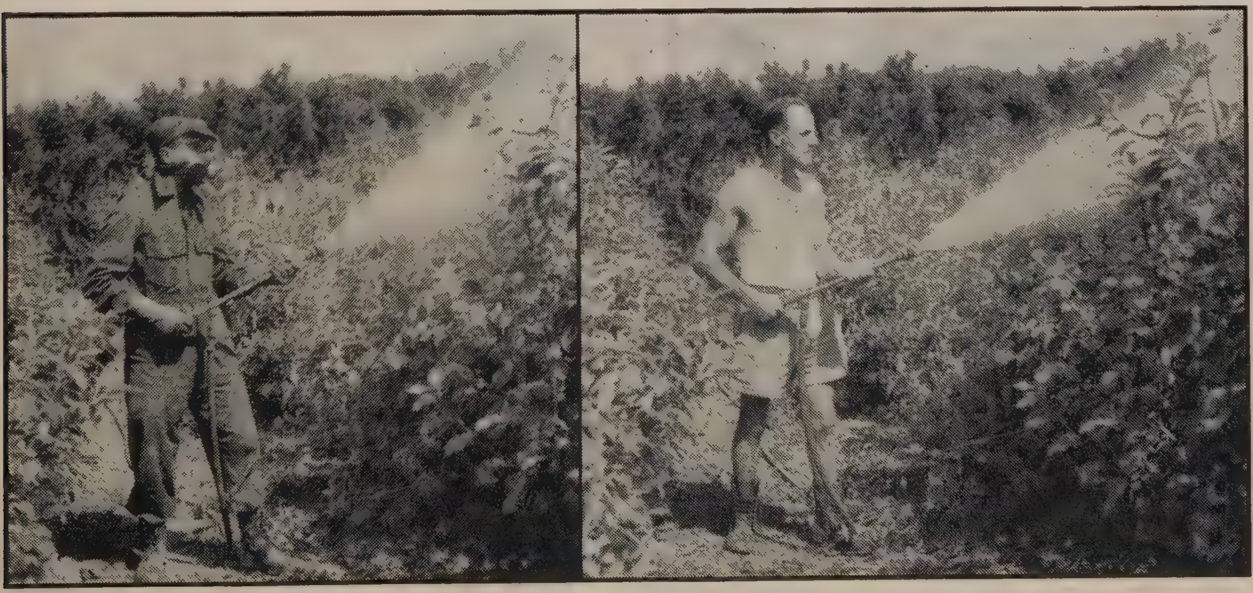
Arsenicals: Lead arsenate, paris green (cupric aceto-arsenate), calcium arsenate, and magnesium arsenate, etc. should be handled and stored with care. Small doses have been recorded as fatal to warm-blooded animals, and application of sprays or dusts based on these substances must be discontinued several weeks before harvest. Operators should remove contamination from spray drift with soap and running water. Legal limits in the U.S.A. for lead and arsenic on fruits and vegetables are 0.05 grains (7 p.p.m.) and 0.025 grains (3.5 p.p.m.) respectively (Webster, 1949). If residues are higher than those allowed by legal tolerances, they have to be removed by washing in dilute hydrochloric acid solutions (0.125 to 2 per cent.), the fruit being washed afterward in running water (Dewberry, 1950). In New Zealand the tolerance for arsenic has been established as 1.5 p.p.m. This amount has not been exceeded when recommendations for application periods have been observed.

Fluorine compounds (Cryolite, calcium fluosilicate, sodium fluoride, barium fluosilicate, sodium fluosilicate, etc.) are dangerous chemicals and should be treated like the arsenicals. The legal limit for fluorine in the U.S.A. is 0.05 grains per pound (7 p.p.m.). It is understood that the use of these materials is prohibited in Britain. Fluorine compounds are not used in New Zealand.

Selenium has been used for control of mites and is formulated with potassium and ammonium sulphide. Because of their high toxicity to warm-blooded animals, selenium compounds are not recommended for use on food crops. In other countries no tolerances are established and produce sprayed with selenium is subject to seizure if an excessive amount of the metal is found. Livestock consuming seleniferous plants may be affected by staggering, and consumption of large amounts may cause death. Although available data show very small quantities in and on fruit sprayed with selenium compounds, effects similar to those observed on livestock may follow accumulation of selenium in the body over a number of years. Intake of 3 p.p.m. of body weight may produce a liver disease known as cirrhosis within a year (Anon., 1951). Authorities in the U.S.A. and Britain discourage the use of selenium on edible plant produce. Ingestion of minute amounts of selenium can initiate insidious poisoning which may be symptomless in the early stages, but later may cause irreparable damage (Anon., 1951). Long-term investigations to elucidate the selenium problem are required to provide information on the advisability of using this material in plant protection.

Chlorinated Hydrocarbons

D.D.T. (dichloro diphenyl trichloroethane) in solid form is innocuous when applied to the skin. Solutions, however, especially those in oil, are readily absorbed, and repeated exposure is dangerous. Toxicity to animal species is selective. Ingestion of D.D.T. at a dose of 1oz. may be fatal. Symptoms of poisoning usually begin with giddiness, nervous tension, tremors of the head and neck, and convulsive seizures, finally reaching a stage of depression and respiratory difficulties. Potential hazards of smaller doses of D.D.T. taken over a period are considerable (Fitzhugh, 1948). Pathological changes of the liver occur on consumption of a diet containing 5 p.p.m. for 4 to 6 months (Lang and others, 1950). D.D.T. accumulates in the animal body when fed in small doses (1 p.p.m.) over a period and there is a progressive rise in storage with time, independent of the level of intake. Old and young animals accumulate D.D.T. at the same rate. The rate of disappearance of D.D.T. is slow (Lehman, 1949). D.D.T. stored in body fat of lactating animals may be excreted in the milk produced



Orchard spraying from the ground. Left—Nozzle man avoiding exposure by wearing protective clothing. Right—Nozzle man exposed to risks from skin and respiratory absorption.

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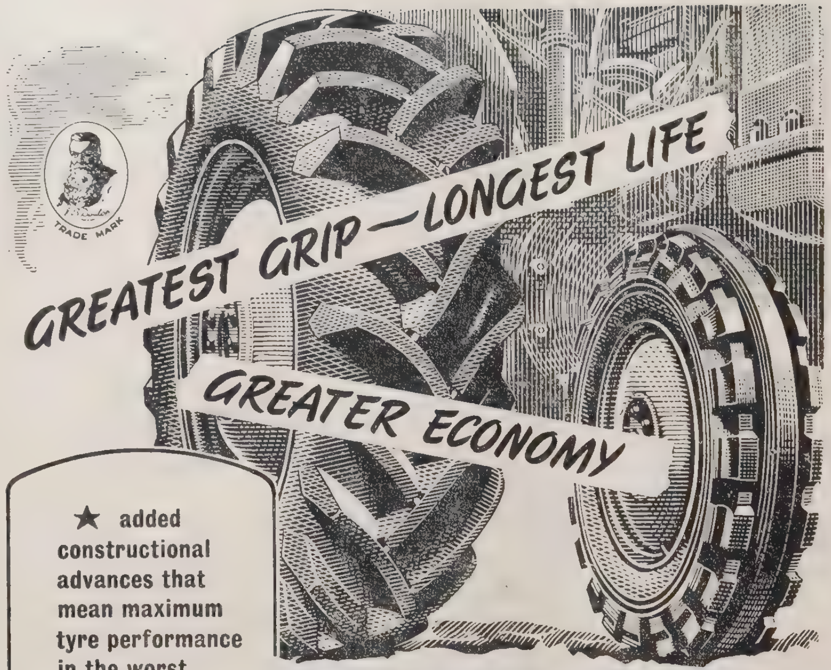
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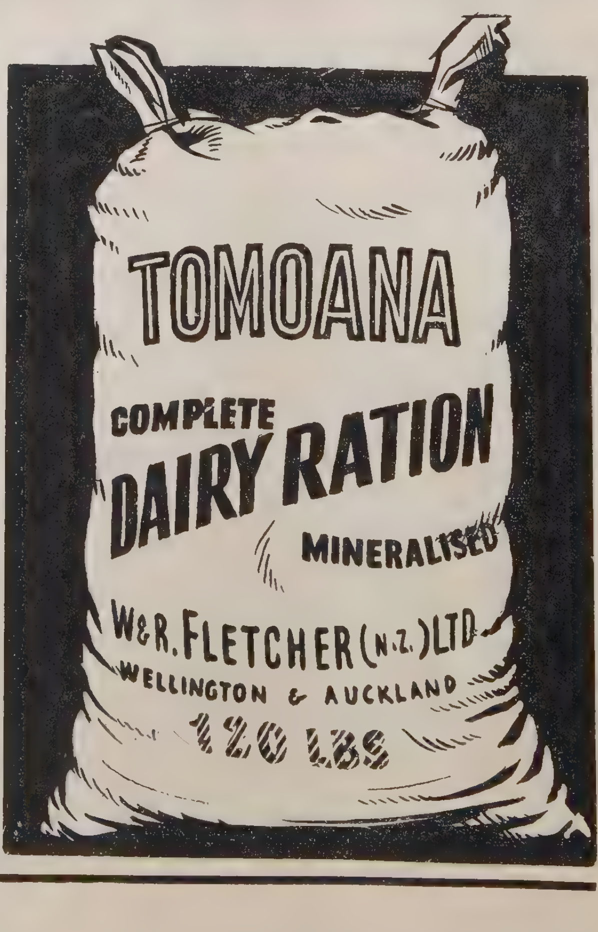
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Operator exposed to health hazards from spray drift, which could also be harmful to people in the neighbourhood.

(Anon., 1951) and D.D.T. may occur in human fat and milk. Clinical data are as yet not available to assess dangers associated with D.D.T. stored in the fat or excreted in the milk in the quantities reported (0.05 p.p.m.). (Lang and others, 1951). Treatment of acute poisoning should be directed toward removal of D.D.T. from the stomach and intestinal tract. Oil purgatives must be avoided and the stability of D.D.T. precludes the use of chemical antidotes. Nervous disorders may be treated with phenobarbital (Lehman, 1949). The following precautions should be observed:—

1. Avoid inhalation of D.D.T.-bearing dusts or spray mists.
2. Avoid contamination of food and of kitchen utensils.
3. Wash off immediately with soap and warm water D.D.T. solutions spilt on skin or clothing.
4. Do not use D.D.T. on fodder crops and dairy cattle or in dairy sheds (Anon., 1951).
5. Use respirators when applying solutions in confined conditions.
6. Do not apply D.D.T. to crops approaching maturity, thus allowing for reduction of residue to a safe level by weathering.
7. Use protective clothing when applying D.D.T. solutions continuously (pest-control operators).

Methoxychlor (methoxy diphenyl trichloroethane) is innocuous to the skin in powder form, but solutions may be absorbed. Very large quantities would have to be ingested to produce toxic effects, the fatal dose being 1lb. at one time. Pathological changes occur in the kidneys after intake of high levels (5000 p.p.m.) in the diet (Lehman, 1949). Methoxychlor is safer than D.D.T. and its use on dairy animals and in dairy sheds is permitted (Webster, 1949), as no deposition in fat occurs, because the breakdown of the compound is too rapid in the body to allow storage (Anon., 1951c; Kunze and others, 1950).

D.D.D. or rothane (dichloro diphenyl dichloroethane) is slightly irritating to the skin. Symptoms of poisoning fall into the category of lethargy (Lehman, 1949). The fatal dose is about 10 times larger than that of D.D.T.—8 to 10oz. of the solid material. Chronic toxicity effects bring about liver damage. D.D.D. is stored in the body fat to an even greater extent that D.D.T., but its chronic effect is only half that of D.D.T. (Anon., 1951b). Precautions similar to those listed for D.D.T. should be observed.

Toxaphene (chlorinated camphene) is moderately irritating to the skin. Symptoms are similar to those brought about by camphor—convulsions. Toxaphene is about four times as toxic as D.D.T. and the fatal dose is approximately 2 to 7 gms. (¼oz.). The fatal period is from 1 to 24 hours. Pathologic changes similar to those caused by D.D.T. occur in the liver. Treatment consists of evacuation of stomach and bowels and experimental control of convulsions by phenobarbital. Bromides, which are used for camphor convulsions, may be useful (Lehman, 1949). Precautions similar to those given for D.D.T. should be rigorously observed.

Azobenzene compounds present no hazard by contact or exposure to workers who use them for spraying and glasshouse fumigation (Blauvelt, 1946). Despite previous suspicions azobenzene has not been found to be carcinogenic (giving rise to malignant tumours). (Kinosita, 1936; Elson and others, 1944.)

Benzene hexachloride (B.H.C.) consists of a mixture of several forms known as isomers. Five isomers have been identified and named alpha, beta, gamma, delta, and epsilon. The gamma isomer is more toxic to insects than any of the others and the efficacy of a B.H.C. product is based on gamma content. B.H.C. is a skin irritant the intensity of which is in direct proportion to the gamma isomer content. Toxicity on ingestion increases with repeated exposure, fatal quantities being about quarter to half that for D.D.T. Symptoms are excitability and convulsions. The pathological effects resemble those caused by D.D.T. Liver damage is characteristic and there is a moderate degree of renal degeneration. Young animals are more susceptible to B.H.C. than are adults. There are no specific antidotes for B.H.C. and treatments are similar to those for D.D.T. (Lehman, 1949). Since the material is apparently not stored in the body, the danger from chronic toxicity is low (Lang, 1948; Riemschneider, 1951). By comparison with D.D.T. the gamma isomer of B.H.C. is quarter as toxic, the beta isomer is two to three times as toxic, and the alpha isomer and technical B.H.C. are of the same order of chronic toxicity (Fitzhugh and others, 1950). Upon removal of B.H.C. from the diet of rats, alpha, gamma, and delta isomers disappear from rat fat deposits within 3 weeks; the beta still persists in small amounts after 14 weeks (Davidow and others, 1951). **Lindane** has been selected as the common name for the gamma isomer of B.H.C. of a purity of not less than 99 per cent. Although lindane is less acutely toxic to warm-blooded animals than D.D.T., the precautions given for D.D.T. should be observed. The use of lindane in dairy sheds has been approved by U.S.A. authorities and low-percentage dusts or dips containing lindane may be used on livestock, as it is not stored to any marked extent in animal fat.

Chlordane (octochloro tetrahydroindane) is moderately irritating to the skin and is absorbed through the skin; a daily exposure of 2.4 grains in solution may be dangerous. Young warm-blooded animals are more susceptible than adults. Early symptoms of irritability lead to convulsions followed by a period of depression. According to Lehman (1949) chlordane is half as poisonous as D.D.T., but the side effects are such that toxicity is about 5 times that of D.D.T. (fatal dose between 5 and 60 grains). Symptoms occur within 45 minutes after ingestion, and if the patient survives to the sixth day, he usually recovers. Degeneration of the liver occurs as a result of chronic poisoning. Removal of the poison from the intestinal tract and stomach and symptomatic treatment are recommended. A respirator and rubber gloves should be worn when chlordane sprays are being applied. When liquid is spilt over the skin it should be washed off immediately with soap and running water.

Operator wearing a military respirator and rubber gloves when filling soil injector with soil fumigant.

Aldrin (hexachloro hexahydro dimethano naphthalene) and **dieldrin** (hexachloro epoxy octahydro dimethano naphthalene) are the most toxic of the chlorinated hydrocarbons. A fatal dose is 5 mg. per kilogram (Lehman, 1949). Precautions similar to those recommended for chlordane should be observed until further data are available.

Aramite (p-tertiary butylphenoxy isopropyl chloroethyl sulphite): Little is known of the toxicity of this substance. Precautions given for D.D.T. should be observed.

Thiocyanates

Lethanes and **thanites** are solutions in kerosene which are of marked acute toxicity. Recovery from acute effects assures survival. Precautions given for phosphate insecticides must be observed.

Insecticide Activators

Insecticide activators include a group of compounds enhancing the insecticidal effects of rotenone and pyrethrins—n-propyl isome, piperonyl butoxide, and "Octacide" (n-octyl bicyclo-heptene dicarboximide). These compounds are relatively safe. Poisoning may be induced by very large doses only (10 to 12 grammes per kilogram) and there is only a minor hazard (Lehman, 1949).

Organic Phosphorus Compounds

Organic phosphorus compounds, although very effective insecticides, are extremely poisonous to man owing to inhibiting effects on cholinesterase (an enzyme essential to life). They can be absorbed through the skin, eyes, respiratory tract, and from the gastro-intestinal tract. The compounds are almost odourless and only slightly irritant to the skin. As effects are very difficult to detect at an early stage, extreme caution is recommended when using organic phosphorus insecticides.

H.E.T.P. (hexaethyl tetraphosphate) contains 15 to 20 per cent. pyrophosphorus acid-tetraethylester and **T.E.P.P.** (tetraethyl pyrophosphate) 30 to 40 per cent. of pyrophosphorus acid tetraethylester. The different concentrations arise because during manufacture different amounts of the effective tetraethylester are obtained. No cumulative toxic effect has been observed with H.E.T.P. or T.E.P.P., as they are rapidly detoxified through hydrolysis in the body (Dubois, 1950). These materials are of extremely high acute toxicity and are readily absorbed through the skin, and the following precautions must be rigorously observed when using H.E.T.P. or T.E.P.P.:—

1. Avoid allowing them to come in contact with the skin, especially when handling concentrates; Wear natural rubber gloves, overalls, and eye shields. Operators should wash with soap and water after completion of an application and should change their clothing, which should be washed before re-use.

2. Avoid inhalation of mist, dust, or aerosol by wearing a respirator, especially when working in a confined space.

3. Avoid contamination of food and eating and smoking in the spraying area.

4. Seek medical assistance immediately symptoms of poisoning develop. As these compounds have no residual action, they do not bring about consumer risks from sprayed produce.

Parathions comprise a group of chemicals such as diethyl or dimethyl, nitrophenyl, thiophosphate, or ethyl p-nitrophenyl thionobenzene phosphonate (E.P.N.-300). These compounds decompose more slowly than T.E.P.P. and 30 days should be allowed between the last application and harvest (Lehman, 1949). Parathion is not stored in body tissues to a measurable extent, but harmful results may accrue from repeated exposure. The toxicity of the above compounds results mainly from inhibition of cholinesterase.

Schradan compounds ("Pestox III", "Sytam", etc.) are based on bis dimethylaminophosphonous anhydride, a chemical which is absorbed by the plant and makes the sap toxic to sucking insects for 4 to 5 weeks. These materials should not be applied later than 6 weeks before harvest. **"Isopestox"** (bis monoisopropylamino fluorophosphine) has systemic insecticidal properties lasting from 2 to 3 weeks. It is supposed to be less toxic than any other phosphate insecticide, but until more is known about this compound precautions given for this group should be observed. It should not be applied later than 3 to 4 weeks before harvest.

Although the organic phosphorus compounds present little risk to the consumer if applied according to recommendations, they are dangerous to people applying them. The following information applies to all organic phosphorus compounds.

Although only slightly irritating to the skin, they penetrate it readily in all types of formulations. No local symptoms on the skin are observed and exposure is not recognised until internal symptoms appear (Bidstrup, 1950). The toxic manifestations of T.E.P.P. and parathion are similar, whereas schradan compounds may not be as direct in action as cholinesterase inhibitors (Lehman, 1949; David, 1951; Garland, 1952). Poisoning symptoms are described by Grob (1950) and summarised as follows by Garland (1952):—

Early: Headache and giddiness, nausea, tight feeling in chest, restlessness and anxiety, blurred vision and lachrymation.

Later: Vomiting, abdominal colic, sweating and salivation, muscular twitchings, increased restlessness, rapid breathing, and incontinence.

Terminal: Pulmonary oedema, respiratory paralysis, coma, and cardiac arrest.

Poisonous doses by ingestion are from 12 to 20 milligrams; a small drop of the concentrate materials splashed into the eye may be fatal. The fatal period depends on the quantity ingested, but generally is from ½ to 4 hours (Lehman, 1949). Treatments recommended are removal of the poison from the stomach and intestinal tract and administration of atropine at doses of 1/60 grain (1 mg.) to 1/30 grain (2 mg.) hourly intravenously or intramuscularly. In Britain field workers engaged in contract spraying are issued with 1/100-grain atropine tablets (David, 1951) and in the U.S.A. ampins containing 2 mg. (1/32 gr.) of atropine sulphate in 1-millilitre buffered solutions are issued to workers. These consist of a unit containing an ampule and needle and allowing for administration of the antidote by the worker, who injects it into his thigh (this treatment is accepted by the U.S. civilian defence authorities). A more detailed description of treatments is given by Garland (1952). Operators affected by organic phosphorus compounds should avoid further exposure for 4 to 6 weeks. Blood-cholinesterase estimation should be performed before further exposure (David, 1951).

Recommendations made by the Zuckerman committee in Britain (Anon., 1951c), given briefly, follow.

Protective clothing to be worn when:—

1. Mixing spray materials: Overalls (of white material, fastening at neck and wrists), rubber boots, rubber apron, rubber gloves, eye shields outdoors, or respirator indoors.
2. Spraying crops: Overalls, hood (of white cloth to cover the head and the back and sides of the neck), eye shields, rubber boots, rubber gloves.
3. Spraying trees: Rubber coat, sou'-wester, eye shields, rubber boots, rubber gloves.
4. Glasshouse fumigation: Respirators should be worn by operators entering atmosphere charged with smoke or spray; for spraying, overalls, hood, rubber boots, rubber gloves, and respirator should be worn.
5. Tractor spraying: With an air-conditioned cab (see illustration on page 70) the driver should wear overalls and rubber boots.
6. For a cab not air conditioned (see illustration on page 77) the driver should wear overalls, hood, rubber boots, rubber gloves, and eye shields.

Nozzle men should wear overalls, hood, rubber coat, rubber gloves, rubber boots, and eye shields. Overalls and hoods should be laundered frequently. All protective clothing should be removed after spraying. Tractor cabs should be tested for their gas-proof efficiency. Washing facilities should be provided near the scene of spraying operations. Working periods should not exceed 10 hours a day and 6 days a week. Operators with colds or stomach upsets should not be engaged in spraying operations. Eating, drinking, and smoking should be forbidden on the spraying area. Machinery and equipment should be washed thoroughly at the end of each day. Blocked jets should not be cleared by blowing them out with the mouth. Materials used in plant protection should be properly labelled, giving poison warnings, dangers, precautions, antidotes, and purposes for which the product is to be used. Spraying operations should be suspended in windy weather, animals should be kept out of areas recently sprayed, and workers and others should be warned not to enter them. Materials should be stored in an orderly and safe manner and storage places should be inaccessible to children and animals. Anti-splash devices should be fitted to containers holding concentrated solutions. Surplus materials should be safely disposed of to avoid contamination of ponds and streams.

RECOMMENDATIONS

The use of plant therapeutants and the development of new chemicals for the control of plant diseases and pests are necessary if the increasing demand for more food is to be met. Many of these chemicals, both old and new, present certain health hazards. Operators may suffer both acute and chronic toxic effects, and residues on plant produce may constitute a danger to the public. Generally, however, most cases of poisoning so far reported have been caused by ignorance or carelessness.

Toxicological studies lead to estimation of maximum residue limits on treated produce. The only tentative limits established so far are 1.5 p.p.m. for arsenic and 7 p.p.m. for D.D.T. According to Lehman (1949b) the following residual values (p.p.m.) may be assigned to certain of the insecticides:—

Insecticide	Residual value p.p.m.
Chlordane ..	Less than 1 if all of the food consumed is contaminated; 5 as upper limit for any single item
D.D.D. ..	5
D.D.T. ..	As for chlordane
Gamma isomer of B.H.C. .	3 to 5
Insecticide activators ..	10
Methoxychlor	10
Parathion ..	2
Pyrethrins ..	10
Rotenone ..	5
Technical B.H.C. ..	As for chlordane
T.E.P.P. ..	Rapidly decomposed; not considered a hazard
Toxaphene ..	5

These values may change as further information becomes available. Food (including milk and meat) containing detectable residue of organic chloride is to be regarded as contaminated, as determination of this chemical indicates the presence of residues from various chlorinated hydrocarbons, identification of which is not always possible.

Recommendations based on information already given are as follows:—

1. Toxicological information on various chemicals should be supplied by manufacturers of products. Hazards and antidotes in cases of accidental exposure should be stated clearly on labels of containers.

[*Sparrow Industrial Pictures Ltd. photo.*

Operators exposed to splash and fume hazards when preparing sprays.

2. Users of plant-protection chemicals (orchardists, market and home gardeners, and farmers) should be instructed as to purposes for which materials are used and also about health risks involved.
3. Growers must be informed on possible toxic residues on products and on safe periods of application of plant therapeutants necessary to reduce such residues to allowable tolerance limits. Investigations should be directed toward establishment of spray schedules limiting application of various chemicals to the safe periods. The rate of absorption of a chemical by various species and varieties of plants should also be assessed, and reduction of spray residues to legal limits should be enforced by examination of produce reaching the market.
4. Toxic effects on operators exposed to chemicals used in plant protection can be avoided by procedures given in paragraph 2, as accidental exposures so far reported have been due mainly to carelessness and ignorance.

Measures listed in paragraph 3 against obscure chronic effects resulting from years of continued ingestion of minute quantities of toxic residues are covered by specific regulations. Risks of poisoning from residues limited to legal tolerances are very slight and the public should be informed accordingly so that "scare campaigns" are avoided. Produce markets could be adversely affected by any type of food poisoning and chronic diseases being blamed on the use of agricultural chemicals. However, control of spray residues, to protect the public, is watched by investigators and no one need deprive himself of valuable food to escape possible dangers.

TABLE 1—POISONOUS ACTION OF SOME PLANT THERAPEUTANTS IN APPROXIMATE ORDER OF TOXICITY

Therapeutant	Crop residues	Absorption through		
		Skin	Inhalation	Ingestion
T.E.P.P.	none	severe	severe	severe
Parathions	yes	severe	severe	severe
H.E.T.P.	none	severe	severe	severe
D.N.O.C.	yes	severe	severe	severe
"Pestox" or "Sytam" ..	yes	severe	severe	severe
Nicotine	none	severe	severe	severe
"Isopestox"	yes	severe	moderate	severe
Selenium	yes	moderate	moderate	severe
Dieldrin	yes	moderate	moderate	light
Aldrin	yes	moderate	moderate	light
Chlordane	yes	slight	slight	moderate
Lead arsenate	yes	slight	slight	moderate
Organic mercury	yes	slight	slight	moderate
Toxaphene	yes	slight	slight	light
D.D.T.	yes	none (dry)	slight	slight
Beta isomer of B.H.C. ..	yes	none	none	moderate
Gamma isomer of B.H.C.	yes	moderate	none	slight
Lethane	yes	light	light	moderate
Technical B.H.C.	yes	moderate	light	slight
Alpha isomer of B.H.C. ..	yes	none	none	slight
Thanite	yes	slight	slight	light
Beta isomer of B.H.C. ..	yes	none	none	slight
D.D.D.	yes	none	slight	none
Rotenone	none	none	light	none
Methoxychlor	yes	none	slight	none
Petroleum oils	none	none	none	slight
Pyrethrins	none	none	slight	none
Lime sulphur	none	light	none	slight
Dithiocarbamates	none	slight	none	slight
Quinones	none	slight	none	slight
"Octacide" (SR-406) ..	none	none	none	none
N-propyl isome	none	none	none	slight
Piperonyl butoxide ..	none	none	none	none

TABLE 2—TOXIC ACTION OF INSECTICIDES INTERPRETED IN TERMS OF HUMAN TOXICOLOGY
(Lehman, 1948 and 1949)

Therapeutant (concentrates)	Quantities dangerous upon skin application (gms. per kg.)			Ingestion estimated fatal dose (gms.)	Period	Predominant symptoms	Treatment
	Single exposure (gms.)		Multiple exposure (gms. per day)				
	Dry	Solution					
T.E.P.P. ..	—	0.6	0.3	0.012	1-4 hrs.	Lachrymation, salivation, sweating, nausea, vomiting, diarrhoea, respiratory distress, disturbance of vision, headache, muscular tremor	General and symptomatic; atropine, magnesium sulphate
Parathions ..	2	3	0.3	0.012	1-4 hrs.		
H.E.T.P. ..	—	5	0.3	0.012	1-4 hrs.		
Nicotine ..	—	3	2.4	0.060	minutes	Tremors, convulsions, paralysis	General; artificial respiration
Chlordane ..	—	113	2.4	5-60	1-4 days	Convulsions, depression	General and symptomatic
Toxaphene ..	—	—	—	7	4-24 hrs.	Epileptiform convulsions	General; phenobarbital
D.D.T.	none	169	9	30	2-24 hrs.	Giddiness, nervous tension, muscular tremors, convulsions, depression	General; phenobarbital
B.H.C.	none	3	1.2	30	1-5 days	Irritability, convulsions, depression	General and symptomatic
Lethanes ..	—	30-300	7.5-30	28-70	12 hrs.	Depression, cyanosis, dyspepsia, convulsions, paralysis	General and symptomatic
D.D.D.	—	169	6	300	2-4 days	Lethargy	
Rotenone ..	none	none	—	200	2-3 days	Stupor, convulsions, depression	General and symptomatic
Methoxychlor ..	—	169	36	450	2-4 days	Tremors, depression	General and symptomatic
Pyrethrins ..	—	—	—	100	3-5 days	Inco-ordination, tremors, paralysis	General and symptomatic

A representative list of chemicals, showing poisonous action in approximate order of toxicity (Lehman, 1948 and 1949; Bailey and others, 1951), is given in Table 1. A summary of toxic actions of some insecticides is given in Table 2.

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PACK-UP SNACKS

PREPARING lunches for children to take to school is part of the daily routine of most country housewives, and often a meal must also be packed for a man working too far from the house to return at midday. This article offers tasty suggestions for preventing the menu of such meals lapsing into monotony.

TWO important rules apply to the organising of these meals: First, they must be given as much variety as possible, and, second, a preponderance of dry food must be avoided, each meal including some fresh fruit, raw vegetable, or tomato.

Sandwich Surprise

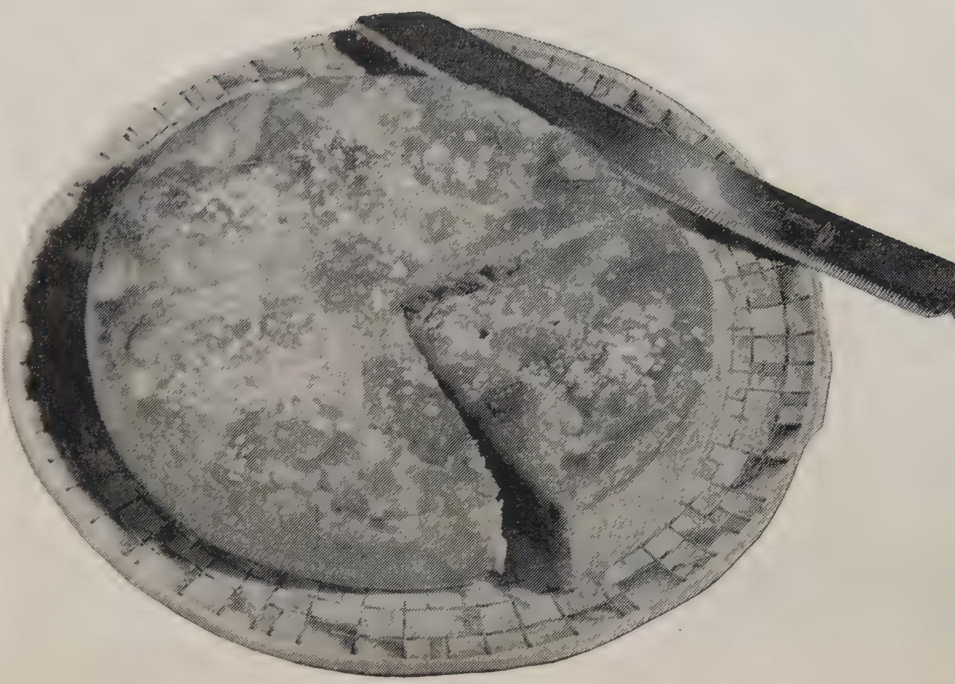
A sandwich loaf
Butter
Meat extract
Worcester sauce
Cream cheese
Seasoning
Lettuce or mustard and cress

Prepare fillings by chopping the lettuce or mustard and cress finely and seasoning it and by creaming the cheese with a little Worcester sauce. Cut the loaf into four lengthways and spread each slice with butter. Spread one slice with meat extract and the other two with the fillings. Reform the loaf by putting the slices together and place them under a weight. When they are adhering firmly cut the loaf across so that each slice has three fillings.

Rabbit and Macaroni Mould

A rabbit
½oz. of gelatine
Mixed herbs
Seasoning
4oz. of macaroni
2oz. of ham
Lettuce leaves

Cut the rabbit into joints and simmer it with the herbs and seasoning until it is tender. Remove the rabbit from the stock. Strain the stock and stiffen it with the gelatine. Line small moulds with the jelly and then with strips of the cooked macaroni. When the jelly has set put in layers of rabbit meat, cut into neat pieces, and slices of ham. Fill up the moulds with jelly and put them in a cool place to set.



Apple and raisin pie is nourishing, remains moist and fresh, and is easy to pack.

The moulds should be packed with washed lettuce leaves.

Sausage Roly-poly

8oz. of flour
2oz. of shredded suet
A pinch of salt
½lb. of sausage meat
1 onion

Sieve the flour and salt into a basin, add the chopped suet, and mix them to a light dough with cold water. Roll the pastry into an oblong and moisten the edges with cold water. Spread it with the sausage meat and cover that with the chopped onion. Roll up the pastry and fasten it in a pudding cloth. Put it into fast-boiling water and boil it for 2 hours. When the roll is cold slice it and pack it with lettuce.

Apple and Raisin Pie

8oz. of pastry
1lb. of apples
3oz. of raisins
2oz. of brown sugar
Rind and juice of a lemon
½ teaspoon of cinnamon

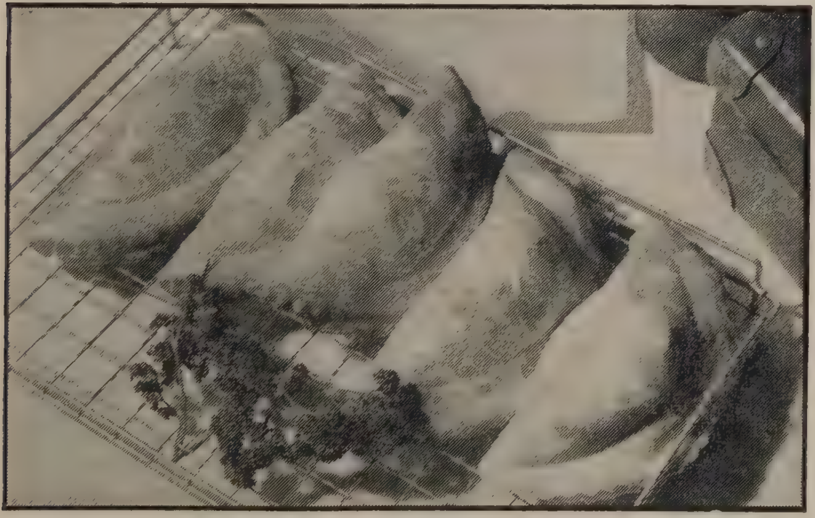
Peel and grate the apples and stone and chop the raisins. Add them to the lemon rind and juice, sugar, and cinnamon, and mix them well. Cut the pastry into halves and roll one half out to a round to fit a plate or flan tin. Fill it with the fruit mixture, damp the edges, and cover it with the second round of pastry. Brush the top with water and sprinkle it lightly with castor sugar. Bake the pie for 40 minutes in a hot oven.

Norwich Pasties

3 tomatoes
4oz. of pastry
1 onion
½lb. of mashed potatoes
Seasoning
1oz. of dripping
1 egg
1 dessertspoon of fine sago

Chop the onion finely and fry it in the dripping until it is golden brown. Add the sliced tomatoes and cook them until they are tender. Turn the onion and tomatoes into a basin. Put 2 tablespoons of water into the frying pan, add the sago, and simmer it until it becomes a brown jelly. Add the mashed potatoes, beaten egg, tomato and onion mixture, and seasoning.

Roll out the pastry ¼in. thick and cut it into rounds the size of a saucer. Moisten the edges, fill the rounds with the mixture, and seal the edges. Put the pasties on a baking sheet and bake them in a hot oven for 30 minutes or until they are golden brown.



Norwich pasties are savoury and satisfying. They are filled with potatoes, egg, and tomatoes and flavoured with onion.

DRAWN-THREAD EMBROIDERY

DRAWN-THREAD embroidery is one of the oldest means of ornamenting woven fabric. From the first attempts at this work by the removal of several fine threads and the replacement of them with one coarse thread of a contrasting colour the art has developed until the complexity of drawn-thread lace has been achieved. Very few people would have the time or the eyesight to attempt the work of a lace cloth, but there are simple drawn-thread stitches that are easy to learn and not very difficult to do. This article by Helen Paine, Field Officer in Rural Sociology, Department of Agriculture, Wellington, deals with the preparation of material for drawn-thread embroidery, the equipment used, and some simple border stitches. In a series of paragraphs that follow a variety of decorative stitches is described.

DRAWN-THREAD embroidery is worked by pulling out threads from suitable material and ornamenting the open strands with stitches. Table mats, tray and table cloths, cushion covers, and handkerchiefs can all be embroidered with drawn-thread work if suitable material is chosen.

Linen dresses and some underwear can be embroidered in this way if the pattern is adapted so that threads can be pulled out across the straight grain of the fabric. Coarse linen is the easiest material to work with in doing these stitches; the threads can be counted without difficulty and can be pulled out easily.

When material is being bought it should be examined to see that the threads are as even as possible in both directions. Handmade linen is particularly satisfactory, because the same yarn is used for warp and weft. Other suitable materials are hessian, linen, canvas, rayon, organdie, and lawn. The material should be of good quality because the drawn-thread work is very strong and durable and will outlast all but the best fabric.

Of the other equipment necessary scissors and needles are the most important. Ordinary scissors can be used, but special embroidery scissors with fine blades from 3 to 4in. long and tapering gradually to the points are more suitable for picking up and cutting individual threads. Crewel needles have to be used, and for most stitches they should be blunt, so that the needle point does not split the threads. Special needles can sometimes be bought, but it is possible to use a crewel needle with the point filed off.

The thread used should be of the same thickness or slightly thicker than a strand of the material, and in most cases of the same colour as the material. Attractive effects may be obtained by using threads of the same colour but of a lighter or darker shade. Contrasting colours can be used, but they are not very effective for this work where the aim is to create a design in the spaces made by drawing out threads. Many different types of threads can be used—stranded cotton, crochet cottons, mercerised lustre cotton, or any genuine linen or flax threads of a suitable thickness.

The thread to be inserted will be referred to as cotton to distinguish it from a thread or strand of material.

Though an embroidery frame is not necessary for the stitches described here, it is essential for many of the open forms of drawn-thread work. Frames are used to keep the material which is being embroidered taut and to prevent it from puckering. There are many sorts of frames, but the most satisfactory one for drawn-thread work consists of two hoops, one inside the other, with a screw adjustment on the outer frame. If this is unobtainable, a home-made frame can be made from two hoops of different sizes with the smaller one wound round with cloth to make the fit tight enough to hold the material. The area of material that is being worked on is placed in the middle of the inner hoop and stretched over the edge. The outer frame is then placed over the material and adjusted so that the material cannot slip out of position.

Preparation of the Material

Before drawn-thread embroidery is done it is necessary to straighten the material by drawing a thread out across the width of the material and cutting along the line it makes. The whole thread need not be removed as long as it is drawn enough for the worker to follow the line. When a piece of material is to be divided into smaller pieces threads should be drawn so that the divisions are marked clearly and then the material is cut along these grain lines. As soon as a piece of material is cut to size the hem should be turned in, the corners cut, and the whole border tacked to prevent fraying. There are two ways of turning the corners of a hem; the choice is determined by the width of the hem and the border stitch that is to be embroidered.

When only a narrow hem is to be turned down and hemstitched the material is prepared as follows and the corner is turned as described and illustrated in Figs. 1, 2, 3, and 4.

A margin is left double the width of the required hem plus ¼in. and then a thread is removed at this distance from each side of the material, from edge to edge. When this line has been marked further threads can be drawn out from the inner side of it until the desired width of the hemstitch insertion is reached. In handkerchiefs 1/10in. is sufficient, but up to 1in. is not too much for very coarse hessian. The raw edge is turned in, then the hem, and both are ironed carefully. When the creases are well marked the material is opened out and a section is cut off from each corner to reduce the bulk turned in. The corners are cut as indicated in Fig. 2. From the left the raw edge of the first side is turned in and the hem folded over and tacked, then the second side is turned, and so on round the cloth.

Hemstitches

There are at least three ways of hemstitching; all result in much the same appearance. Two of them are described. At least 4 threads should be drawn out for the narrowest hemstitch insertion. Then with the hem toward the body the thread is fixed at the left-hand corner on the wrong side of the material and work proceeds from left to right. The needle is inserted 4 threads to the right at position A (Fig. 5). It is brought up again 4 threads to the left of A at B. It is inserted again at A and brought up through 2 threads of the hem. That is the complete stitch, which is then repeated. At a corner the stitch is worked through a double layer of drawn strands. On the right side this just shows as a straight stitch gathering strands of the insertion together. Four strands hemstitched together are the usual number for medium fine material, but more or fewer may be necessary for some fabrics.

Another Hemstitch

The hem is turned down as before, and with the hem over the first finger of the left hand and the material toward the body this stitch is worked from right to left. The cotton is secured under the hem and brought up 4 threads from the corner and one or 2 threads into the hem. While the cotton is held under the left thumb the needle is inserted 4 threads to the right at A (Fig. 6) and brought up 4 threads to the left of A at position B to form a buttonhole loop through the cotton. Insert the needle again at B and bring it up through the hem and 2 threads along to the left at C. Here the stitch is repeated. This stitch shows as an oblique line on the right side of the material.

Simple Hemstitch

When either of the hemstitches described is worked on one side only of an insertion and is used to secure a hem it forms a simple hemstitch.

Open Hemstitch

The open hemstitch is worked by embroidering a hemstitch on both sides of the insertion. To work the second side the cotton is attached in the hem and then carried across the insertion to look like one of the strands. On the inner edge the hemstitch is the same, except that there is no hem to stitch down. The same strands that have been caught together at the hem are now grouped together by the stitches at the inner edge and form a row of straight bars. The completed stitch is known as **straight bar hemstitch** (Fig. 7).

A variation on this stitch is worked very easily by hemstitching the inner bars differently. The bars must have an even number of strands for this stitch. As four is the usual number, the stitch will be described for four. The first 2 strands of the first bar are hemstitched together, then the remaining two are caught with the first two of the next bar, and so on to form a diagonal bar hemstitch (Fig. 8).

Variation of Hemstitch

This variation on the ordinary hemstitch requires very little extra work. An ordinary straight bar hemstitch is worked, with a wider insertion than usual, and 3 or 4 strands in each cluster. The bars are then crossed in this way. Thread a needle with a length of cotton longer than the side of the cloth. Secure the cotton in the hem on the right-hand side of the material, or attach the cotton with one or two knotted loops to the first bar of the hemstitch. This cotton must be caught firmly. Working on the right side of the material, carry the needle and cotton across the middle of the first two bars and insert the needle in the space marked A (Fig. 9) beyond the first two bars. Bring the needle up in the space B between the bars, carry it over the first bar to point C, and back under both bars, so twisting the first under the second. This twisting stitch is repeated with the next two bars and so on along the row. This can be done with matching thread, or if the open hemstitch is wide enough, it can be done with ribbon. The ribbon stitch is particularly suitable for underclothes.

Hemstitch Border with Knots

Embroider a wide border of hemstitch, at least ½in. even for the finest materials. Attach the cotton as described for the last stitch. Loop the cotton round 3 or 4 bars of hemstitch (Fig. 10), then pass the needle under the bars to be knotted together and through the loop. Repeat this stitch, drawing clusters together all along the border. The same cotton that was used for the hemstitching can also be used for the knots, but a different cotton in a bright colour and perhaps of a coarser material can be used.

When the insertion made by drawing out threads is greater than ½in. it is best not to draw the threads right out to the edge of the material, but just to the margin within the hem. When a number of threads are pulled out in both directions from a corner the corner is left cut away. The edge from which the threads are cut should be buttonholed or caught with satin stitch to prevent threads from fraying (Figs. 11 and 12). If the corner is to be left solid, the threads have to be pulled out in a different way, but should also be buttonholed or satin stitched first. The corners, too, are turned in differently and are mitred. This leaves a solid margin of material surrounding the embroidery. A line of threads is pulled out to mark the margin of the hem; these are not pulled out right across the material, but are pulled only to the inner margin of the corner. The margin of cloth within which the first threads are pulled is double the width of the hem plus ¼in. Mark the approximate margin at the corners with coloured thread or tailor's chalk.

Beginning at one of the marked corners raise a thread, snip it, and draw it until the point at which the thread meets the margin marked on the opposite side is obvious. Snip the thread at this point and pull it right out. Returning to the first corner, snip the thread running at right angles to but starting at the same point as the first one drawn. Pull it and snip it at the margin on the opposite side; then draw it out. At the second and third corners now marked snip the threads at right angles to those already drawn and pull them both until the point at which they cross can be seen; snip both threads here and pull them out. The inner margin is now marked by the threads that have been withdrawn. The hem is turned down to this margin and the corners mitred.

To Mitre a Corner

(Figs. 13, 14, 15, and 16)

Fold in the raw edge about ¼in.; then fold over the hem to the margin and

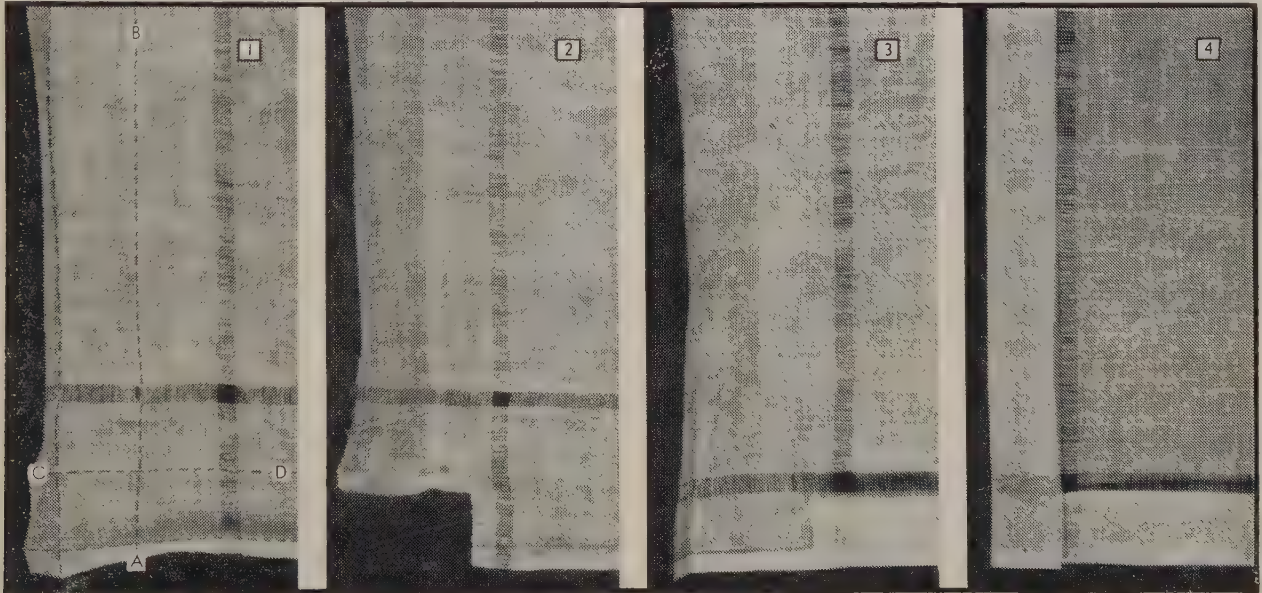
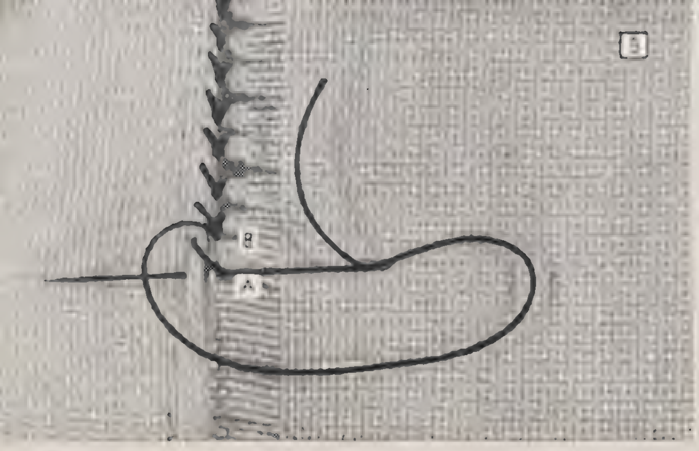


Fig. 1—Threads are drawn out for hemstitching, the raw edge is then turned in, and creases are made along the lines AB and CD where the hem is to be turned down. Fig. 2—A section is cut from each corner to reduce the bulk turned in. Cut ¼in. from the crease CD on one side and ¼in. from the withdrawn threads on the other. Fig. 3—The raw edge is turned in and the hem along the side CD is folded. Fig. 4—The corner is completed by turning the raw edge on the other side in and folding along the crease AB.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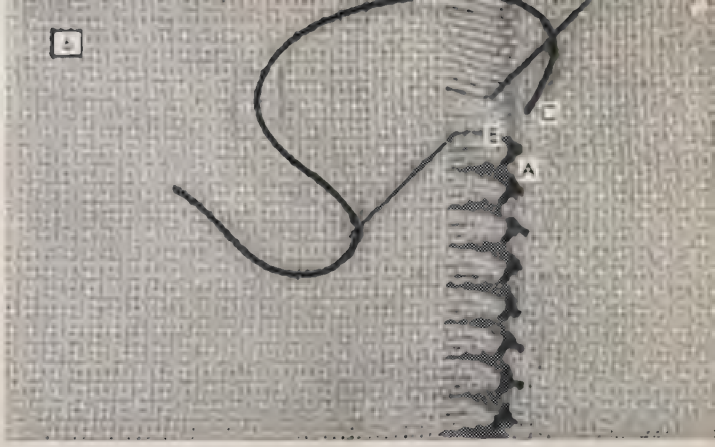
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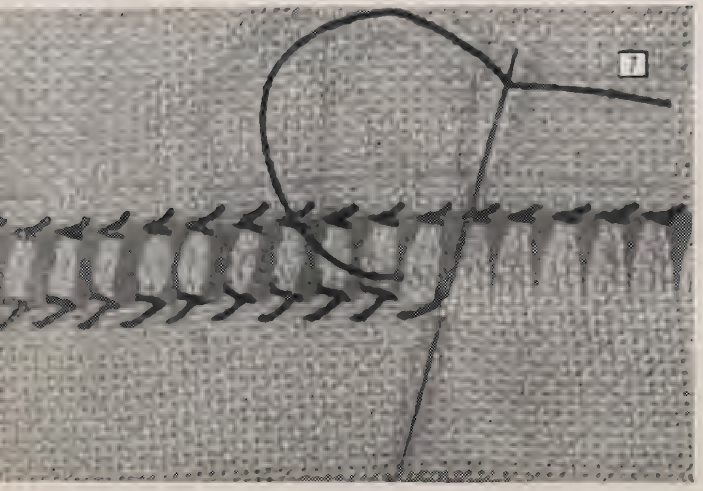
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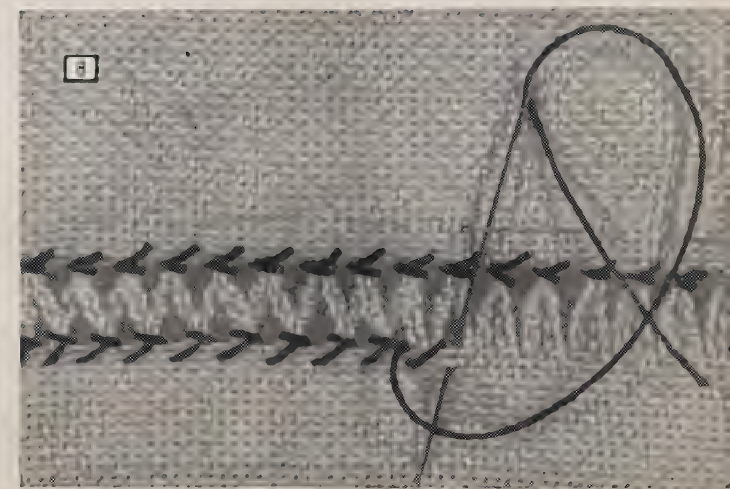
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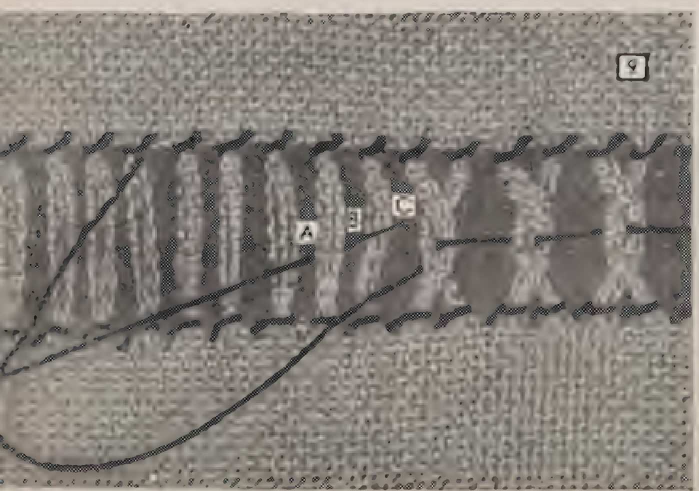
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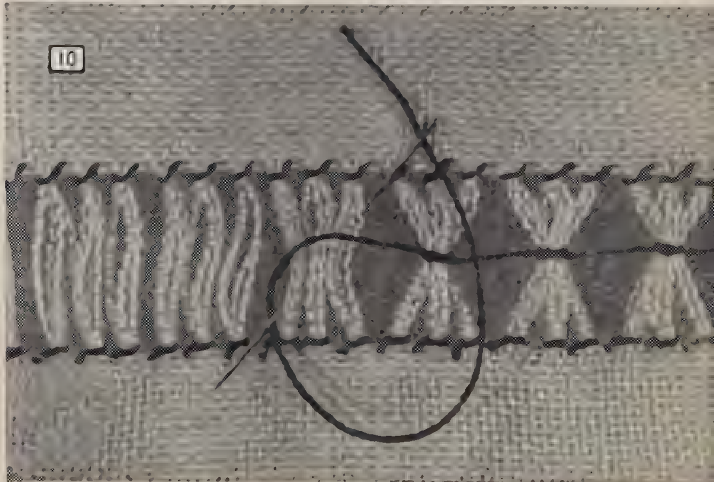
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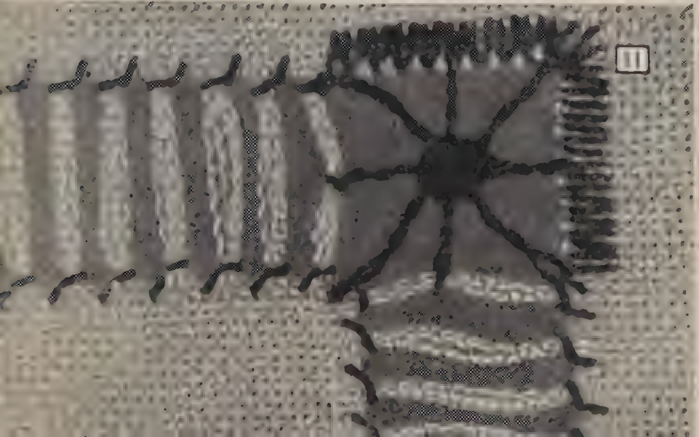
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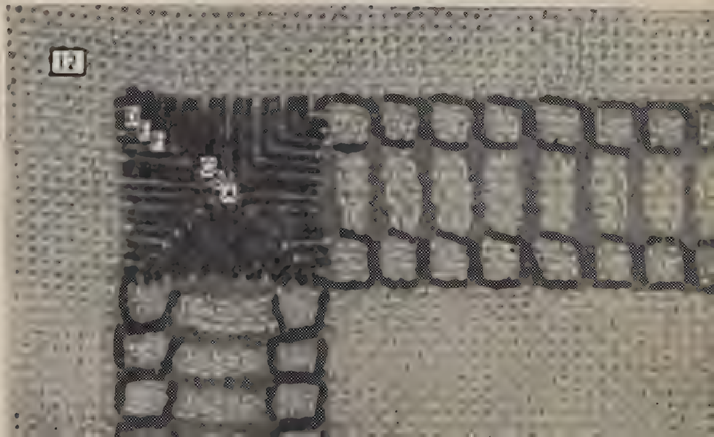
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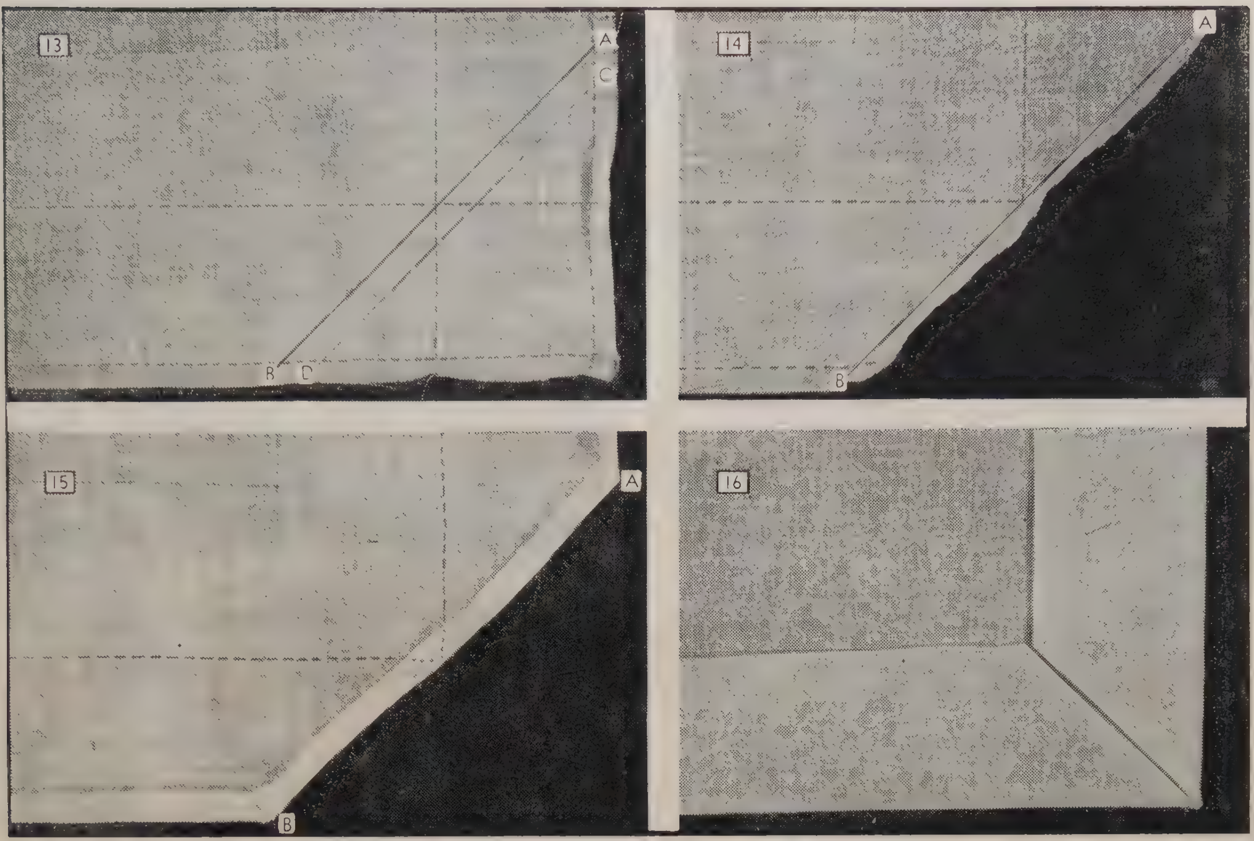


To mitre a corner. Fig. 13—One thread is withdrawn to mark the margin of the hem. The raw edge is turned in and then the hem is folded along the lines marked. Each corner is then opened out, and a fold made across it along the line AB. Fig. 14—A section of the corner is cut off ¼ to ½in. from the line AB. Fig. 15—The raw edge cut off from the corner is turned in. Fig. 16—The hem is turned down where the creases are already marked.

iron it carefully. When the fold has been clearly marked with the creasing, open out the material. The folds of the corner should look like those in Fig. 13. Another fold is made along the line AB across the corner of the first fold. The corner of the material is then cut away along the line CD ¼ to ½in. outside the fold AB. The raw edge is turned in again so that the raw edge formed at the corner is folded along the line AB. The hem should then be turned in where the creases are already marked and the corners folded in to the inner margin. The border should then be ironed and tacked.

It takes a little practice to mitre corners well, but a corner looks much neater turned in this way than any other. When the corner has been turned in and the hem tacked the border can be embroidered. Wide as well as narrow borders can easily be worked within the margin.

Open Corners

hemstitching. Fig. 8—Diagonal bar or

For a wide border the ends of the threads to be drawn out are first caught in a satin stitch or buttonhole stitch (Fig. 11). Thread a needle with the embroidery cotton, and, starting from the corner, count to the left the number of threads that are to be withdrawn. Bring the needle up from the back and, holding the cotton so that it gets caught in the back of the stitch, insert the needle 4 threads up. Bring the needle up each time between the threads at the bottom row, moving along one thread at a time, and insert it between the same threads four above.

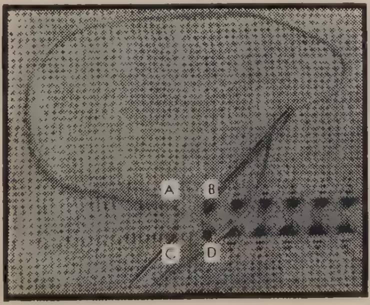


Fig. 17—Square stitch.

When the margin is satin stitched up to the inside corner it is turned as follows: Bring the needle up in the corner and insert it as usual 4 threads above, but bring it up in the corner again. Insert it this time 4 threads up and 2 threads along and bring it up again in the corner. Insert it 4 threads up and two more along from the last stitch, bring it up in the corner. The next stitch is the beginning of the row in the other direction. The needle is inserted 4 threads up and two to the right of the last stitch. The next stitch again from the corner is also 4 threads up and two to the right. The needle is not brought up in the corner after this stitch, but is moved along the bottom again. The corner is now turned and the satin stitch is worked in the other direction. This is done in all 4 corners, and then the threads on the inside of the satin stitch are cut and pulled. The empty corner may be filled in with any suitable design like the web illustrated (Fig. 11).

Illustrations on opposite page: Fig. 5—Simple hemstitch No. 1. Fig. 6—Simple hemstitch No. 2. Fig. 7—Straight bar trellis hemstitching. Fig. 9—Hemstitching with twist. Fig. 10—Hemstitching with knots. Fig. 11—Open-worked corner. Fig. 12—Solid-worked corner.

To Work the Corner

Thread the needle with the same cotton that has been used for the satin stitch and carry 4 threads across the space, 2 threads straight across the open space, and 2 threads diagonally. Carry the last thread only to the centre, then knot all the threads together by weaving the needle and cotton under one and over the next and so on round in a circle until the desired amount has been filled in. Carry the thread across the last space and fix it in the satin stitch at the corner.

A Filled-in Corner (Fig. 11)

When the border stitch is done in an insertion of 8 threads drawn out, and 4 threads left on either side of the insertion, the corner could be worked in the following way. From the corner marked by the first thread drawn out, count 8 threads down and 8 threads in to the centre, and bring the needle up in what will be the centre of the corner A. Insert it 8 threads up in the same line, bringing it up again one thread above the first and one thread to the right at B. Insert it again 7 threads above. Bring the needle up next one thread above and one to the right of the last at C, and insert it 6 threads above. Proceed in this way until the needle is inserted just one thread above, at position D. Turn the material 90 degrees in a clockwise direction to work the next side. Bring the needle up again at D and insert one thread above in the new direction. Bring it up at E and insert 2 threads above. Bring it up also at F and insert it 3 threads above. Proceed in this way. One quarter of the corner will be filled when the needle is brought up at A and the other 3 quarters are worked in the same way.

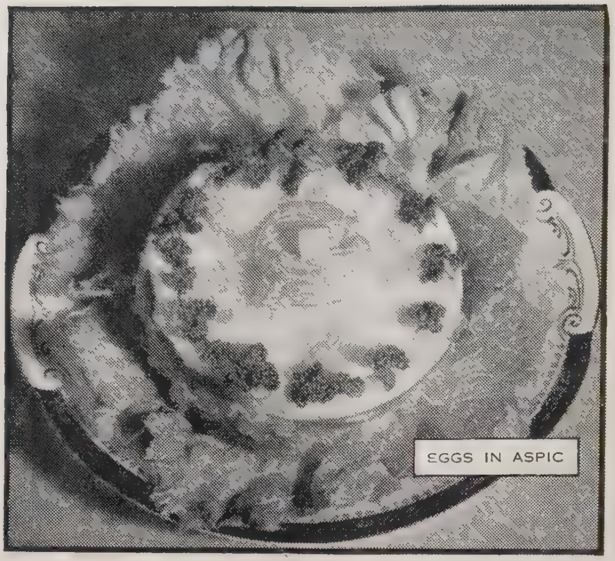
Another Border Stitch

Another border stitch that is very effective, though it does not actually hem the material, is square stitch. This is a decorative stitch that is done with cotton a little coarser than a strand of the material and with a blunt needle.

The first line of threads is pulled out to the margin as described above, the hem is tacked, and the corners mitred. Then a second inner line of threads is pulled out 4 threads within the first. Starting on any corner, count 4 threads along the line already drawn out and snip the fifth thread. Do the same on the opposite side, making sure to cut the same thread, and then pull it out. Do this on all four sides. Square stitch is worked on the 4 threads between those drawn out. It is not essential that threads are pulled out, but it makes the line of the threads very much easier to follow and the holes made by the embroidery form a more definite pattern.

The work is done from right to left on the right side of the material with the hem over the first finger of the left hand and held away from the body. The needle and cotton are brought up from the wrong side in the top line from which the threads have been withdrawn 4 threads to the left of the corner at position A (Fig. 17). The end of the cotton is not attached to the hem, but is held on the underside of the work by the left hand until it is secured by the stitches. The needle is inserted 4 threads to the right at position B and brought up diagonally across on the bottom line 4 threads down and 4 threads to the right at position C. The needle is then inserted 4 threads to the right on the bottom line at D and brought up at C again. It is inserted 4 threads up from C at position A and brought up 4 threads to the left on the top line. This is the starting point of the next stitch. The upward stitch from C to A can be done twice to make the form of the square stitch more definite. When the stitch is finished the hem is sewn down with a slip stitch that is caught into the holes of the square stitch.

Aspic Makes Appetising Dishes


EGGS IN ASPIC

DURING summer difficulty is sometimes experienced in the preparation of a cool, appetising meal, because the various salad ingredients are not quite ready for eating. Cold savoury dishes, however, may be prepared by making savoury jellies and serving them in lettuce leaves, garnished with parsley or lemon. Nell Macpherson, Field Officer in Rural Sociology, Department of Agriculture, Auckland, here gives recipes and descriptions for making appetising dishes.

AN aspic is a savoury jelly made with stock and gelatine and it is used for making cold meat, fish, or vegetable moulds.

Aspic Jelly

2 cups of stock or water
¼ cup of cold water
1 tablespoon of gelatine
Sufficient Worcestershire sauce, lemon juice, salt, and pepper for flavouring

Soak the gelatine in cold water, then dissolve it over hot water. Season the stock to taste. Add the dissolved gelatine, stir the mixture thoroughly, and strain it. These quantities make one pint.

Tongues in Aspic

1 sheep's tongue per person
4 cloves
1 tablespoon of vinegar
1 tablespoon of salt

Boil the tongues in water or stock to which the salt and cloves have been added. When the tongues are cooked lift them out of the stock, skin them, and place them in a wet mould. Add the vinegar to the stock and then mix the stock with gelatine in the proportions for aspic given above. Pour the aspic over the tongues and put parsley sprigs and green peas in it. Allow it to set overnight. Unmould the tongues and serve them on lettuce leaves.

Eggs in Aspic (Individual Serving)

1 egg
¼ cup of chopped ham
¼ cup of tomato pulp
½ cup of aspic jelly

Poach the egg and trim it to fit the mould. Slide it into the wet mould upside down. Mix the ham and tomato pulp and fill the mould with the mixture. Pour the aspic jelly into the mould and put it aside to set. Unmould the jelly on to a nest of lettuce and put a spoonful of mayonnaise on top of the aspic or round the base of it.

Tomato Aspic Loaf

6 small tomatoes
2 tablespoons of mayonnaise
2 cups of flaked cooked fish
1 pint of aspic jelly

Place the tomatoes in a bowl and pour boiling water over them to loosen the skins. Remove them from the boiling water and peel them. Cut a small slice off the end of each tomato and scoop out the pulp. Fill the hollow cases with the flaked fish mixed with the mayonnaise. Mix the tomato pulp with the aspic jelly and run a thin layer of it into a wet loaf tin. Allow 3 to 5 minutes for the jelly to set. Place the filled tomato shells upside down in the loaf tin and pour in a little more aspic. Allow it to set again. Pour on the remainder of the aspic jelly and allow it to set overnight. Unmould the loaf on to an oblong plate and arrange sprigs of parsley and slices of lemon round it.

Jellied Beetroot

2 medium-sized beetroot
1 medium-sized onion
2 tablespoons of vinegar
½ pint of aspic jelly or 1 dessertspoon of gelatine dissolved in 1 cup of boiling water
Sugar

Cook the beetroot. Peel and slice the onion and the beetroot. Arrange the slices of beetroot and onion in layers in a wet loaf tin and sprinkle each layer with a little sugar. Add the vinegar to the aspic jelly and pour it over the beetroot and onion. Allow the jelly to set, then unmould and serve it. Cut in slices or wedges, jellied beetroot is an attractive addition to any picnic lunch.

Many combinations of foods may be set in aspic and it is largely experience and family preferences which decide the mixtures.

Heading photograph by Sparrow Industrial Pictures Ltd.

Growing Flowering Plants for Indoor Display

FEW garden subjects are of greater interest to the gardener and the family than pot plants or window box plants. Provided careful preparations are made, few difficulties will be found in the cultivation of pot and box plants, and in this month's article for the flower gardener C. K. Ellis, Horticulturist, Department of Agriculture, Dunedin, deals with the preparation of the potting soils required and other details of the subject.

AS plants growing in pots and boxes are in highly artificial surroundings, the general aim of the gardener should be to simulate as nearly as possible the natural conditions required by such subjects. Basic requirements include the provision of a good soil mixture, a knowledge of the correct methods of potting up and potting on, a good understanding of the water requirements of the plants, adequate attention to light and temperature, and the materials necessary for the control of pests and diseases.

Potting Soil

A good potting soil is prepared by mixing loam, peat or leaf compost, and sand.

Loam

A good loam is the base of all good potting and pricking-out mixtures, so the loam selected should be rich and fibrous. Soil from flower borders is not usually fibrous enough to provide the good mechanical condition required of a soil that is to be confined in pots or boxes. The chief attribute of a fibrous soil is that it retains moisture for much longer than does a non-fibrous soil.

The ideal method of obtaining such a loam is to take turf from a grassy paddock known to be of reasonable fertility, cut the turves into blocks about a foot square, and build them grass downward into a stack. The turves should be about 4in. thick so that they include the bulk of the grass roots. Small quantities of lime and well-decayed animal manure can be added when the stack is being built if the soil is not considered sufficiently fertile. After about 6 months the grass plants will have rotted, leaving a large quantity of fibrous material. This turf can then be chopped up with a spade or broken down block by block by hand.

Sterilisation

Though sterilisation of this loam before it is mixed into a compost is desirable, it is not always essential, particularly if the loam is from a fresh pasture. Soil sterilisation as the gardener knows it is only partial sterilisation. Complete sterilisation would not be advantageous, for it would kill all the beneficial bacteria which are normally left alive under present systems of partial sterilisation and would cause great chemical changes which normally have harmful effects on the subsequent growth of plants.

Probably the most convenient method of sterilising soil at home is on an open framework of wood or heavy wire netting in the laundry copper. The soil should be at least 3in. above the top of the water.

Soil to be sterilised should be fairly dry, as even fairly moist soil does not sterilise readily under low-pressure steam. The soil should first be passed through a ⅜in.-mesh sieve and then placed in an open-weave sack or in a kerosene tin with perforated bottom and sides; if a sack is used, it should be only partly filled and spread over the framework so that it covers as much of the area as possible without touching the sides of the copper. The lid should be placed on the copper and the water brought to the boil. The temperature needs to be checked at intervals by the plunging of a thermometer into the soil.

After the soil temperature has been maintained at 180 degrees F. for about 10 minutes the soil should be removed from the copper and spread in a clean place to cool. It should be covered until ready for use, as leaving it to dry in the open air makes it liable to reinfection by harmful fungous spores in the air.

Leaf Mould or Compost

Peat suitable for the potting mixture is not generally available to home gardeners in New Zealand, but a good leaf mould or, failing that, a well-decayed garden compost can be substituted. Both these materials are extremely variable and no general recommendation can be made about the type to use, but it is desirable to sterilise either in the same way as the soil. The leaf mould or compost and the soil should never be sterilised together.

Peat does not need sterilisation.

Sand

The third major ingredient, sand, need not be sterilised. Its purpose in the potting soil is to ensure that the soil is open for free draining, so very fine sand is useless. The average diameter of the grains should be not less than 1/16in.

Mixing

The ingredients are mixed in the proportion of 7 parts by bulk of sterilised loam, 3 parts of sterilised leaf mould or garden compost, and 2 parts of sand. To each bushel (for convenience an apple case may be considered to hold a bushel) should be added 1½oz. of dried blood, 1½oz. of superphosphate, 4/5oz. of sulphate of potash, and ¾oz. of carbonate of lime; greater quantities of fertilisers than these should not be used, as poor results usually follow excessive applications. All these ingredients must be very thoroughly mixed.

Moistness

Whether the soil mixture contains the correct amount of moisture for potting can be ascertained by taking a handful and compressing it by clenching the fist. When the soil is released it should neither fall apart nor remain stuck closely together. A condition halfway between these two extremes is desirable—that is, when the soil roughly retains the shape into which it was compressed but is divided in places by irregular cracks.

A soil mixture which is too dry should not be used for potting and watered afterward, but should be brought to the right condition first. This can be done by spreading the soil in a thin layer and sprinkling it with water from a fine-rosed watering can until the required condition is obtained. Soils which are too wet should be spread to dry to the correct condition before being used.

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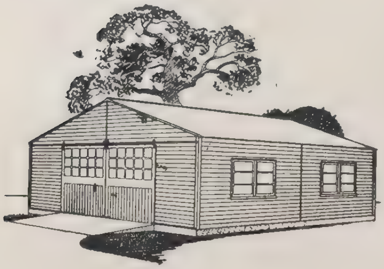

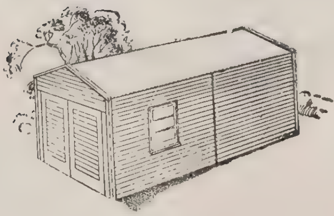

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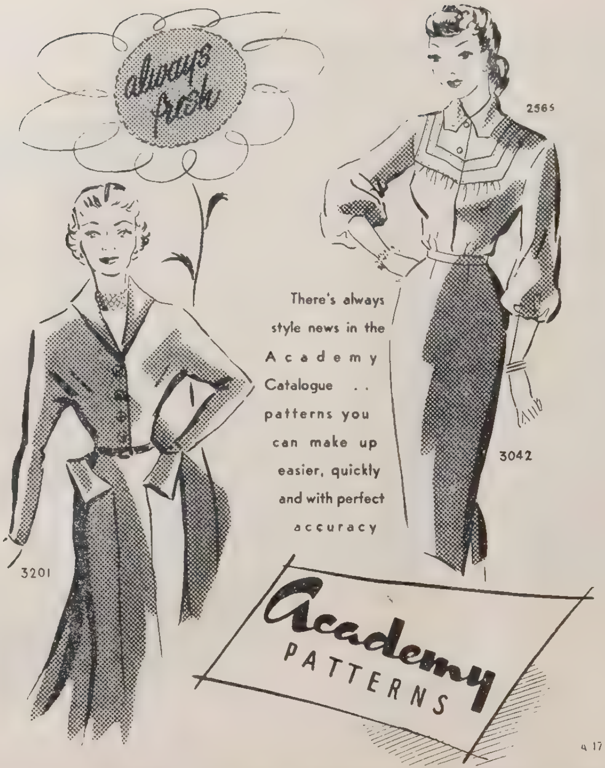
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Hydrangeas, fuchsias, and small palms make excellent pot plants for the house

Potting the Plants

The plants should be grown either in pots or in suitable boxes erected within the protected area of the windows. Boxes need less care than pots because more soil can be placed in them. Moreover, pots are costly, and an increasing number of home gardeners are turning to the use of boxes. On the other hand, pots have several advantages over boxes, probably the chief of which is that plants can be turned out of pots without great disturbance to their root systems, whereas the removal of a plant from a box entails considerable damage to its roots.

Plant pots are dry when bought and must be soaked thoroughly in water and allowed to dry superficially before they are used. Pots which have been used before should be sterilised by being brought to the boil in water and cleaned by being scraped with an old knife and brushed vigorously to remove all green encrustation and old soil. A plant potted up into a dirty pot cannot be turned out again without damage to the fine roots, many of which will stick to the lumps of dirt on the pot and be pulled off.

The pots should be crocked before they are filled by placing in the bottom of each three or four pieces of a broken pot with their convex sides uppermost. Crocking is done to improve drainage.

A small amount of soil is placed in the pot and firmed down, the plant held in the pot at the level at which it should remain after potting has been completed, and the rest of the soil added and firmed down as filling proceeds. When the work is completed the potted plant should have the soil about it at the same level as previously and the soil level should be between ½ and 1in. below the rim of the pot. The plant should then be watered thoroughly by the pot being filled with water to the brim and then allowed to drain before being placed where it is to grow.

Watering Pot Plants

Adequate attention must be given to the subsequent periodic watering of the plants. The average pot plant in a year should receive water equivalent to between 100 and 150in. of rainfall.

Pot plants should never be allowed to flag before being watered. The necessity for watering can be judged by feeling the soil every day or so: If the soil leaves no mark on the skin after the forefinger has been drawn across it, it is too dry; if it leaves a muddy mark, the plant has ample water for at least a further couple of days. Each time a pot is watered it should be filled to the brim, occasional sprinklings of water being useless, as they damp only the upper layers of soil and induce the roots of the plants to rise into this zone.

A plant may be turned out of its pot by placing the fingers on the surface of the soil as illustrated, inverting the pot, and tapping the rim sharply against a wooden ledge.

The greater quantities of soil in boxes than in the 5, 6, and 7in. pots used in the house are not so subject to rapid drying. Therefore waterings need to be less frequent—for larger boxes as infrequent as at 7- or 10-day intervals.

Pests of Pot Plants

Pests most likely to attack house plants are few in number but fairly serious in their effects.

The aphis is probably the most common, and it can be checked by removing the plant to a convenient place and spraying it with nicotine sulphate at a strength of 1 part in 800 of water, plus a teaspoonful of soft soap to a pint as a spreader.

Red spiders and thrips are other likely visitors, and the easiest method by which the home gardener can control them is by spraying with nicotine sulphate at a strength of 1 part in 800 of water plus 1 part per hundred of summer oil.

If mealy bugs appear, they should be brushed off the plants with a soft brush dipped in a mixture of equal parts of methylated spirit and water.

Plants for Pot or Box Culture

Abutilon megapotamicum
Acalypha
Asparagus plumosus
Auricula
Azalea
Begonia (tuberous rooted)
Boronia
Brunfelsia
Cactus and succulents
Camellia (dwarf varieties)
Chrysanthemum (cascade)
Cineraria
Coleus
Croton
Daphne (dwarf types)
Dracaena
Gardenia
Gloxinia
Heliotrope
Helleborus
Impatiens
Kalanchoe
Maranta
Mignonette
Palms (small)
Pelargonium
Plumbago
Primulas
Saintpaulia
Schizanthus
Streptocarpus

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Begonia and gloxinia tubers should be started gently into growth by half burying them in boxes of potting compost, sprinkling them with water, and standing them in a warm, sunny place, preferably in a glasshouse heated at night to prevent the temperature falling too low. Each tuber must be sound and healthy, soft or rotten places being cut out with a sharp knife.

Chrysanthemum propagation can be started at this time of year. Roots which have been left in the border from last year should be divided and replanted in August or September, as newly planted chrysanthemums produce finer flowers than old clumps. Last year's stools which have been put in pots or frames to produce cuttings should be watered when necessary.

Cuttings can now be taken of lobelia, geraniums, heliotrope, and balsams growing in a glasshouse. The cuttings will root easily and provide useful young stock to be planted out when danger of frost is past.

Dahlia propagation should be started in August by putting the roots to be increased into boxes either in frames or on the bench of a glasshouse and packing them round with damp soil, which must not cover the tops of the tubers. In damp, warm conditions new shoots will start to grow rapidly.

Fertilisers should be used regularly on the flower borders in all but the most fertile soils. The most satisfactory system is to dress the whole of the borders each year in August with 2oz. per square yard of complete flower border fertiliser (3 parts by weight of blood and bone, 2 parts of superphosphate, and 1 part of muriate of potash). The dressing often produces astonishing results. Now is the time to measure up the borders, obtain the ingredients, mix them, and apply the mixture evenly over the surface.

Frames are useful for a variety of purposes in the garden and increase the range of plants that can be propagated and grown at home. Even if a proper frame is not available, every garden should at least have a substantial wooden box, from which top and bottom have been removed, partly sunk in the soil to make it more stable and keep out cold draughts, and covered at the top with a sheet of glass. A frame enables plants to be kept moister, warmer, or drier according to their requirements at different times of the year than those in the open ground.

Fuchsias in pots which have been rested through the winter should be brought out again in August, put in a warm, sunny window, and watered. When the buds start to grow the plants should be turned out of their pots, the roots shaken free of soil, and the plants re-potted into potting compost. The final step is to prune back each plant to within an inch or two of its base to encourage growth of strong new shoots.

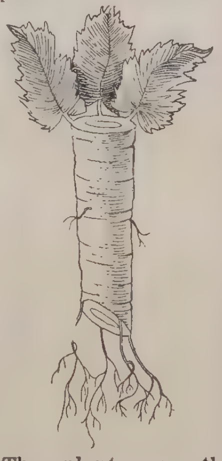
Gladioli do best in a sunny, warm site sheltered from very strong winds and in deep, well-drained soils, but give poor results in shallow soils or hollows where water collects after rain. It is worth while going to some trouble to dig the ground deeply and provide gladioli with the best possible place in the garden where their needs will be most nearly satisfied. Corms in store should be inspected from time to time and any which show bad scars, rotten patches, or scabs should be burnt. Slight infections may be cut out with a sharp knife, though detection of them is difficult until the corms have the outer skins peeled off just before being planted. Planting can be started in August in early districts, but the main planting is not usually made until September or October.

Herbaceous plants should be planted out as soon as possible. Perennial phlox, heleniums, scabious, pyrethrums, and perennial asters are all free flowering and very suitable for the small garden. *Scabiosa caucasica* is one of the best perennials for cutting, providing a long succession of blooms each year. Plants are increased by being lifted, divided, and replanted in autumn or early spring.

Hydrangeas in pots should be started into growth by being put in a warm, sunny place and watered. When growth starts the surface soil should be scraped off and replaced with a layer of new compost with which has been mixed a teaspoon of complete fertiliser for each pot.

Lawns sown last autumn should be mown only with the blades set well above the surface. The level of cut can be lowered gradually as the lawn becomes better established.

Root cuttings can be used to increase stocks of peonies, Oriental poppies, gaillardias, and anchusas. For this interesting method of propagation established plants are dug up in autumn or late winter and pieces of root 2 to 3in. long and as thick as a pencil or thicker are cut off. A root cutting should always be cut square at the top and slanting at the bottom so that one end can be told from the other at a glance. The cuttings are planted upright a few inches apart in boxes of good compost or in a sandy, open soil in a frame, being set so that their tops are just below the surface. **The cuts soon heal,** roots grow from the bottom of each, and one or more shoots appear at the top. The plants are then ready to be planted out, all the shoots but one being removed if several have grown.



Seed may be sown under glass in boxes to produce bedding plants for setting out in October. Salvia bonfire, *Phlox drummondi*, petunias, *Begonia semperflorens*, lobelias, stocks, antirrhinums, sweet wivelsfield and other hybrid dianthus species, *Primula sinensis*, verbenas, nemesias, African and French marigolds, and zinnias are suitable. If a heated greenhouse is available, the best temperature in which to raise seedlings of all these plants is between 60 and 70 degrees F. Seeds of most of the plants listed can be grown in a cold frame without heat, but sowing is better delayed for a few weeks.

Sterilisation of loam, boxes, pots, and other equipment will require attention in preparation for their use for seed sowing, pricking out, and potting. Early spring is a busy time for gardeners, especially those with glasshouses who raise their own bedding plants, but equipment is best not sterilised until just before it will be needed to reduce the risk of their being contaminated again.

Sweet peas can continue to be planted out, 6 to 15in. apart, the closer spacing where the row is being grown for a bold display of colour and the wider spacing if the plants are to be trained as cordons. Arrangements must also be made for supporting the row, using stout posts every 10 to 12ft. and wire netting, sheep netting, manuka brush, or other supports fastened to wires strung near the ground and along the tops of the main supports. Whichever system is used, it must be soundly carried out to stand up to the worst gale likely to occur during summer, when a well-grown row of sweet peas presents a large area to the wind.

Damping-off Disease

Damping off is the most troublesome disease of small seedlings. It is caused by a fungus (*Pythium de baryanum*) which attacks young plants, invading their stems just above soil level and causing them to topple over and die. The disease spreads rapidly and the seedling first attacked is soon surrounded by a widening patch of more dead seedlings. The fungus is spread by fine threads (hyphae) which can just be seen with the naked eye extending in all directions from affected plants.

Good cultural conditions can do much to prevent trouble from damping off. The disease is most common and troublesome where seedlings or young plants are overcrowded, as this results in soft, sappy growth and weak stems which are specially susceptible to attack. Thin sowing of seeds and early pricking out of seedlings does much to prevent damping off. The use of sterilised compost is the other major factor in prevention, as infection usually comes from the soil.

However, damping off sometimes occurs even in sterilised soils. At the first sign of damage the affected groups of seedlings and those for an inch or two around should be lifted out of the box carefully and burnt. The remainder should then be watered with Cheshunt compound, which can be bought ready for use or made by mixing 2 parts by weight of pulverised copper sulphate with 11 parts of ammonium carbonate. After standing for 24 hours in a tightly corked bottle, the mixture is used at the rate of 1oz. dissolved in a little hot water and made up to 2 gallons with cold water. It should be applied as quickly as possible, a quart being used to each square foot of surface.

As a further precaution against damping off, especially if the soil is unsterilised or the seedlings are particularly valuable or vulnerable to attack, the box of soil compost should be watered thoroughly with Cheshunt compound before the seed is sown and sprinkled lightly with it after the seed has been covered with soil. A moist, warm atmosphere is most conducive to an attack of damping-off disease and should be avoided for the raising of seedlings, which make the strongest plants if grown in fairly cool conditions.

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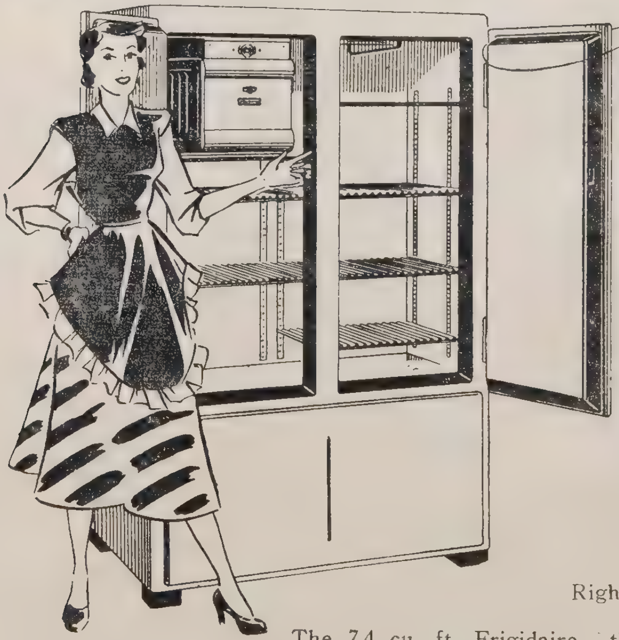

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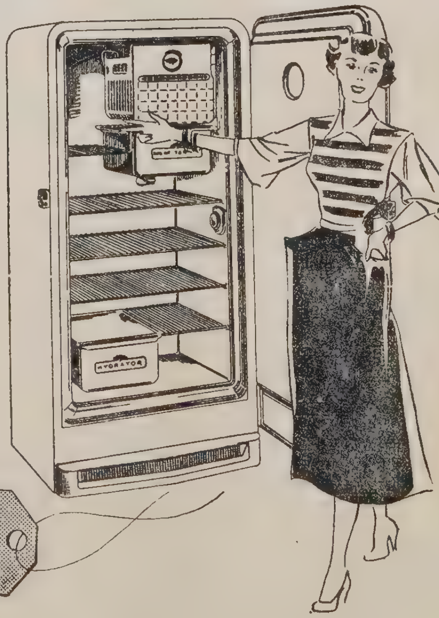

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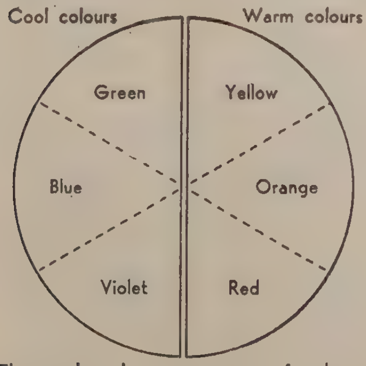
The Successful Use of Colour in the Home

[Sparrow Industrial Pictures Ltd. photo.

THE planning of colour schemes in the home is approached with diffidence o uncertainty by many householders. Drab neutral background colours are used in many houses because they do not show dirt or because they match furnishings. In homes in which ornaments, furnishings, and carpets have been accumulated in a more or less haphazard mixture of colours the effect of the lack of colour planning can be dull and uninteresting. In this article Evelyn E. Moore, Field Officer in Rural Sociology, Department of Agriculture, Palmerston North, discusses the successful use of colour in the home and suggests suitable colour schemes for different rooms.

THE thoughtful use of colour can give the most unpromising material or rooms a new lease of life, but a poorly chosen or unsatisfactory colour scheme can mar the effectiveness of carefully selected and high-quality furnishings and make a room seem crowded, irritating, and drab or dismal and cold.

Colours therefore have an important effect on the emotions, and the effect to be created—of cool restfulness, of warmth and comfort, of cheerfulness, of brightness, or of dignified formality and spaciousness—is one of the first considerations. Thus blue is regarded as a colour giving an impression of coolness and distance, though, unrelieved, it can have a depressing effect too. Red and orange are warm, bright, exciting colours. Green, like blue, is a cool colour, though it is more restful and much less depressing and is therefore one of the most popular colours used in interior decorating. It is close to yellow, the lightest and sunniest of all colours and therefore widely used in various shades and tints for walls, ceilings, and furnishings because of the light, spacious effect it produces. Violet and purple, the most sombre of all colours, are probably the most difficult to use successfully in interior decoration. Well used, however, they give an impression of dignity and graciousness, especially in their lighter tints of lavender or lavender-grey.



The cool and warm groups of colours.

Colours which are combinations of two colours have some of the characteristics of both; a bluish red or crimson is cooler and less flamboyant than a bright orange-red, and yellowish green or lime green is warmer than a blue-green or turquoise.

Colour and Light

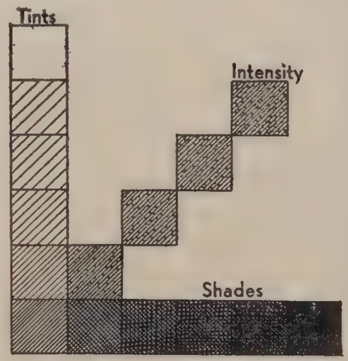
Colour needs light for its revelation, and changes according to the quality and intensity of the light. Consequently in the interior of a house the brilliance and clarity of the colours are controlled by the amount and quality of light falling on them from doors and windows and by the amount of reflection from the surfaces on which they appear; colours in satins and glossy paint surfaces seem brighter than they do in mat surfaces. The aspect of the house and the rooms it contains is therefore an important consideration, and because various means of artificial lighting can be used, it is also necessary to consider the effect on furnishings of the form of lighting chosen if the colour is to be equally pleasing by night and day.

The strength of natural light in a room will depend on the position of windows in relation to the sun; that is, provided their windows are not shaded by trees, a veranda, or an adjacent wall, rooms facing north and west will receive the warmest light. Easterly rooms receive their brightest light in the morning, when it is cooler, and therefore can be effectively furnished in warmer colours than rooms with a westerly aspect. Rooms with a southerly aspect receive the coolest light of all and should generally be furnished in warm colours if they are not to seem cold and cheerless, especially in winter.

Colour can be used to conceal or disguise poor architectural features in a room; for example, ugly mouldings can be concealed by painting them the same colour as their background, or a very low ceiling may be made to seem higher by painting it a light colour and perhaps by using a vertically striped wallpaper.

Successful Colour Combinations

Most successfully decorated rooms—those that are attractive and perfect in their setting—obtain much of their effectiveness from the colours used in their decoration and from the judicious mixing of these colours, for it is the balance of colour rather than the amount of colour used that is important. For example, a room furnished



Adding black to colours produces darker shades; adding white increases the degree of lightness. The intensity or degree of brilliance can be reduced without darkening the colour by adding grey, a mixture of black and white.

exclusively in various shades and tints of pink is seldom as pleasant or as satisfying as one in pale pink relieved with tints or shades of another colour.

Almost everyone knows when combinations of bright colours are incongruous and ugly, but some find it difficult to be certain about pastel, dark, or neutral colours, which, though seldom clashing violently, can more easily look dull and uninteresting.

To understand the behaviour of colours, particularly under electric or fluorescent light, it is necessary to distinguish between the colour of light and the colour of fabrics or paints. Ordinary white light is really a mixture of all the colours of a spectrum or of a rainbow. Reflected through a prism or from rain clouds under certain conditions, the white light breaks up into a band of colours or spectrum in which each colour is closely related to the adjacent one. However, colours of fabrics or paints are dyes or pigments which owe their colour to the light falling on them. In daylight or in white light they show or reflect their true colour, the other colours being absorbed by the pigment; that is, white paint reflects all the colours, but blue paint reflects only blue and red paint only red.

Ordinary electric light is not pure white; there is a predominance of yellow, orange, and red light, and uncoloured fluorescent light contains more blue and green light. That is why so many greens (mixtures of blue and yellow pigment) look different under electric light, the yellow in the mixture being more strongly reflected than the blue and the colour taking on a more yellowish tint.

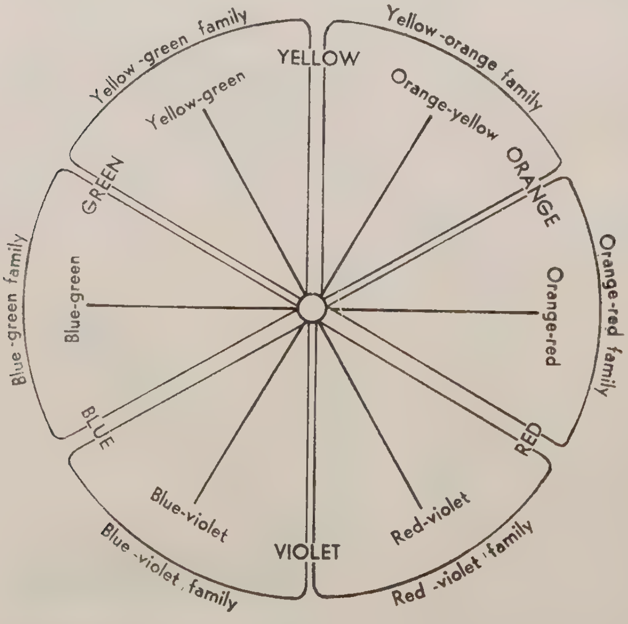
The colours in the spectrum have been standardised into 12 different hues which when arranged in order in a circle form what is known as the colour wheel, which is of considerable practical value in deciding which colours are likely to combine well. The arrangement of these colours in the wheel is shown in the diagram below. These are only the pure colours, from which an almost infinite variety of tints and shades can be obtained either by mixing pure colours with each other or by adding black or white. The addition of white to the pure colours will produce all the delightful pastel colours and tints obtainable; shades result from the mixing of a colour with black.

The brilliance or intensity of a colour can also be altered without making it noticeably lighter or darker. This is done by adding grey or by mixing it with some of its complementary colour—the colour found directly opposite it in the colour wheel. Yellow is complementary to violet, blue to orange, and green to red. Mixed together in equal quantities, pigments of complementary colours produce a brownish grey, but when placed side by side they furnish the sharpest contrast and the colours seem brighter.

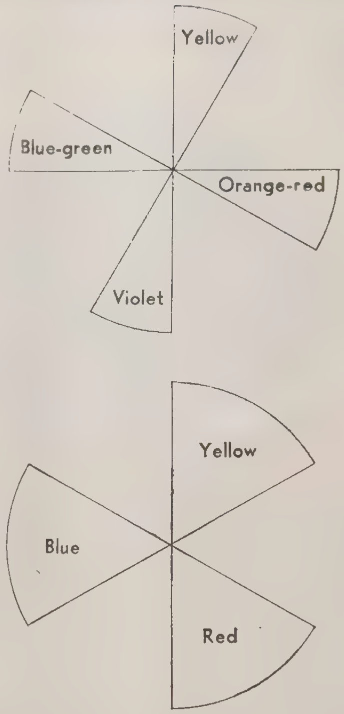
Colours which lie side by side in the colour wheel are related differently, for when mixed together they produce not grey but an intermediate colour, and the intermediate colours so produced go well with the colours mixed to form them. The three pigment colours, red, blue, and yellow, which will produce other colours by being mixed in varying proportions, are called primary colours, and those formed from them, **such as green from blue and yellow,** are called secondary colours. Colour schemes therefore are based on a combination of related or contrasting colours and have distinctive characteristics accordingly. Contrasting colours are striking and related colours are more restful.

Related Colour Scheme

The related colour scheme uses the colours ranging from a primary colour to one of its neighbouring secondary colours in the colour wheel; blue, blue-green, and green and the autumn colours yellow, orange, and red are examples. The diagram of the colour wheel indicates the six colour families that can be obtained in this way. The entire red, orange, and yellow group can be safely used together in suitable shades, tints, and intensities.



The arrangement of the 12 colours in the colour wheel. The three primary colours are yellow, red, and blue and the secondary colours are green, violet, and orange. A related colour scheme uses colours ranging from a primary colour to one of its neighbouring secondary colours. In addition the entire range of colours in both the yellow-orange and the orange-red families may be used together satisfactorily.



The two main contrasting colour schemes, complementary and triad. Upper—The complementary scheme uses colours lying opposite each other in the colour wheel. In the two arrangements shown yellow is combined with violet and blue-green with orange-red. Lower—In the triad colour scheme three colours equidistant from each other are combined. The arrangement shown is composed of the three primary colours, yellow, red, and blue.

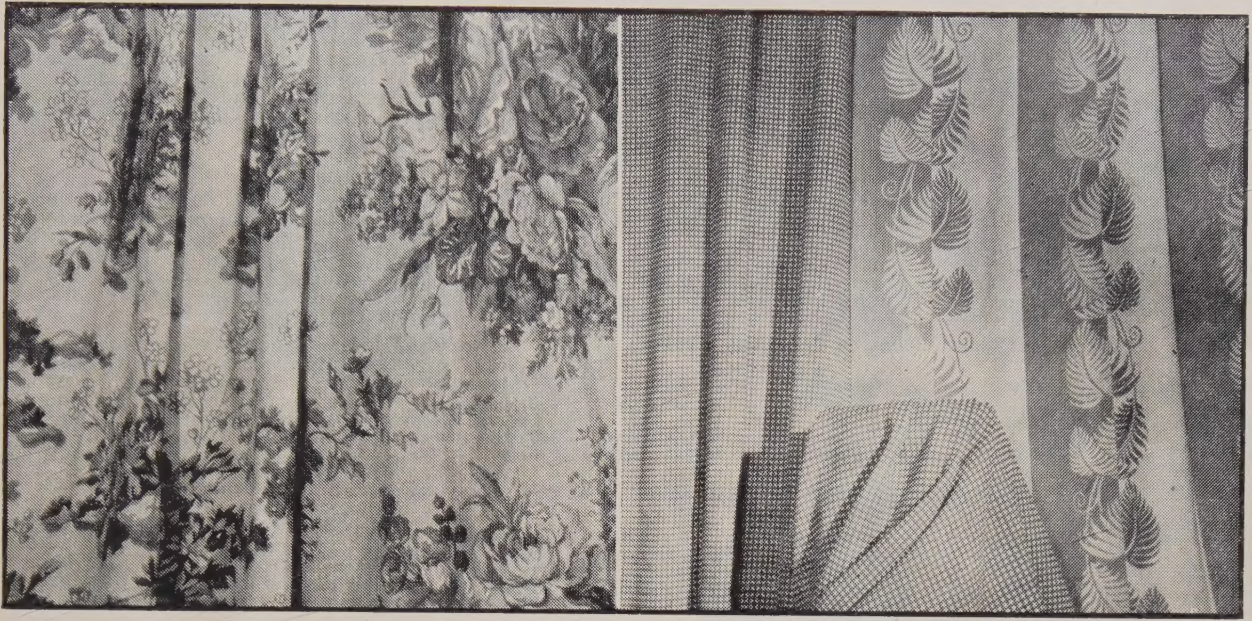
Contrasting Colour Schemes

Contrasting colour schemes are more dramatic and satisfying to the average person than those using adjacent or related colours. In fact most related colour schemes rely for their effectiveness on a touch of a contrasting colour in curtains, flowers, or other accessories. The two main types of contrasting colour schemes are the complementary and the triad. The complementary combines colours which lie opposite each other across the colour wheel, such as red and green or blue and orange. More care is needed in their use than in the use of adjacent colours. Usually they look best when used in very unequal amounts, such as a preponderance of one in pale, dark, or greyed tones with just an accent of the other in a bright colour to enliven the first.

The triad colour scheme uses three colours equidistant from each other in the colour wheel. Thus the three primary colours, red, blue, and yellow if used in suitable tints, shades, or values may make a satisfactory colour scheme.

Choice of Colours

It is obvious in the choice of a colour scheme for a room that though the bright, clear colours may look well



Large floral designs (left) are commonly used in loose covers, curtains, and carpets, but may easily dwarf a small room. Smaller geometrical or regular patterns such as those shown on the right can help create an effect of spaciousness.

together on a handkerchief or in a floral print frock, they would be unsatisfactory if used together as the principal colours in a room. Consequently it is necessary to use light pastel tints or dark, greyed, or neutral colours, together with small areas of a brighter, clear colour or white for accent. Greyed tones of any colour are always excellent for using over large areas, such as in carpets.

Pattern should also be used sparingly in colour schemes, as a variety of different patterns in one room compete for attention and have a confusing effect, but the pattern on one or two patterned articles is emphasised by surrounding plain materials. The values to be given to colours (that is, which to lighten and which to darken) can be decided by considering the relative lightness and darkness of the colours themselves. For example, bright yellow is a much lighter colour than bright violet; other colours are of intermediate lightness. When this relationship is unnaturally disturbed, as, for example, in the combination of a light lavender and dark mustard yellow in a colour scheme, a contrast very unpleasant to the eye is obtained and in interior decoration this type of contrast should be avoided.

The lightness or darkness of the whole colour scheme will depend on the size of the room and how light or dark it is. Small rooms need colours light in value; dark colours can look well in rooms with large window areas. Poorly lighted rooms often look better decorated in brighter rather than lighter colours.

White walls are excellent for giving an effect of lightness, but as they throw the furniture into sharp silhouette, it is better to avoid chalk white unless the lines of the furniture are good. As white invariably has a cool or a warm undertone, it will harmonise better in a room furnished in warm colours if a minute touch of yellow or red is added to the white paint or distemper. Similarly it can be made cooler by adding a touch of blue or green.

In choosing a colour of paint it is advisable to cover a small patch and let it dry in its setting. In judging its suitability allowance should be made for the fact that paint in a small sample generally looks somewhat darker than it will when applied to the whole wall area.

Popular colour schemes such as green or rust and green can be given distinction by the use of an attractive or striking design in curtains or upholstery.

Suggested Colour Schemes

In planning a colour scheme it is advisable to start with some existing patterned material which one finds attractive, such as a carpet or the loose cover or curtain material. Alternatively the colour scheme may be built around the colours in a favourite picture or beautiful piece of china. It is also desirable that the colour schemes of adjoining rooms, a hall and living room or living room and dining room, should harmonise, though they need not match. Some suggested schemes for the various rooms in the house follow.

The Hall

The hall is often one of the darkest parts of a house and therefore light, bright colours are generally appropriate for it. To co-ordinate its scheme with that of the living room the accent or accessory colour of the living room could be used in a lighter value as the main colour in the hall and one of its other colours as the hall accent. Details of two schemes for the hall are given below, one for when the living room main colour is green and the other for when it is yellow-red.

Living room ..	Green	Yellow-red
Hall floor ..	Dark green	Rust
Hall walls ..	Light green	Peach
Hall woodwork and ceiling ..	White	White
Accessory colour	Yellow-green	Green

The Living Room

As the living room is used for entertaining, reading, and writing and sometimes for hobbies and games, glaring or too stimulating colours in it should be avoided. The choice of a carpet or floor covering is usually the one most limited by colours available, and therefore the suggested schemes below have been based on each of the four most common carpet colours available and are given for both cool and dark and for bright, sunny rooms.

The Kitchen

Good kitchen colour schemes are bright and cheerful. White walls are often better avoided in kitchens already containing white stoves, sinks, and refrigerators, though they can look well with bright colours used for accent. Cream is a fresh and popular colour for walls; other good colours are lemon yellow, pale turquoise, pale green, and chartreuse. Suggested colours to use together are: Pale turquoise and cherry red, yellow and shrimp, apricot and pale green, chartreuse and sea green, white and scarlet, and pale yellow-green and deep maroon.

Colour Schemes for Cool Rooms

Carpet or linoleum colour	Walls	Woodwork	Draperies	Accessories
Brown	Light yellow	Light yellow	Yellow-green	Bright green
Dark red ..	Pale pink	Grey	Warm grey	Emerald green
Green	Cream	Cream	Yellow-green	Chinese red
Beige	Pale apricot	Light natural wood	Greyed apricot	Green

Colour Schemes for Sunny Rooms

Carpet or linoleum colour	Walls	Woodwork	Draperies	Accessories
Brown	Pale green	Darker green	Rose (grey-red)	White
Dark red ..	Grey-blue	Grey-white	Yellow-grey	Dark blue
Green	Blue-green	Blue-green	Yellow-green	White
Beige	Pale green	Green	Off white	Wine red

Bedrooms

The colours used in a bedroom usually depend on the preferences of its occupant. Most people probably like a bedroom to be decorated in soothing restful pastels, but some choose brighter and more vivid colours.

The scheme of related colours is good for a bedroom, as it is simple and restful. For rooms with a southerly aspect warm colours are desirable; shades and tints of blue, lavender, and turquoise are restful for a room with a northerly or north-westerly aspect.

Suitable colour schemes for bedrooms are: Powder-blue walls, delicate-peach and blue curtains and covers, and a beige carpet; pale pink walls, greyish-green linoleum or carpet, and rose pink, pale grey, and green for curtains, bedspreads, etc.

☆

Russian Slice Cake

THE Russian slice cake illustrated requires the following ingredients:—

4oz. of butter
5oz. of sugar
6oz. of flour
2 eggs
1 teaspoon of baking powder
A little jam
1 dessertspoon of cocoa
A little milk
A few drops of cochineal
2 tablespoons of warm water

For almond paste:
¼lb. of ground almonds
¼lb. of icing sugar
1 egg
A little lemon juice

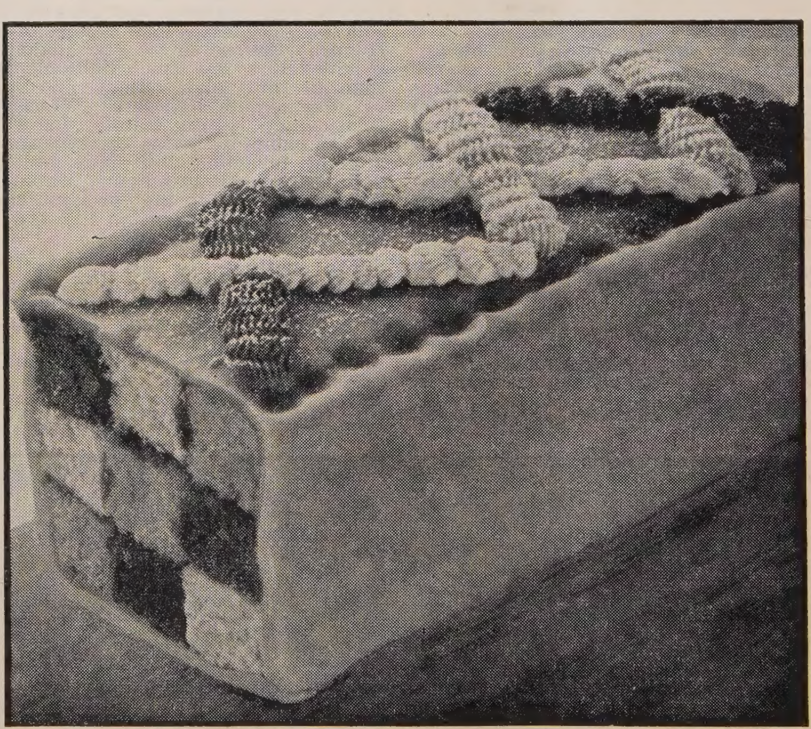
Beat the butter and sugar to a cream, add the eggs gradually, beating well. Add 2 tablespoons of warm water and stir in the flour gently, adding baking powder with the last spoonful. Mix with a little milk to a soft, dropping consistency.

Divide mixture into three parts, leaving one-third plain, add the cocoa to one of the others, and colour the remainder with cochineal.

Grease and line a shallow baking tin, 7in. wide by 10in. long and about 1in. high. Place a double fold of greaseproof paper down the centre of the tin for two-thirds of its length. Then lay a double fold of greaseproof paper across the tin, thus giving three separate compartments.

Fill each with one of the three different coloured mixtures, and flatten the mixture slightly in the centre of each so that it will be quite level when cooked. Bake in a moderate oven for 25 minutes. Turn out and cool.

When cold, cut off the outside edges level, and cut the cakes into even-sized lengths, as wide as they are high, getting three strips out of each colour. Warm a little jam till it is liquid, brush over each strip with it, then press them well together in threes, arranging colours alternately.



Make the almond paste by mixing the almonds and sugar and binding them together with as much of the egg as is necessary. A little lemon juice should be added before the egg for flavour.

Turn on to a board, sprinkle with a little of the flour, and knead thoroughly till quite smooth. Roll out till not quite ¼in. thick. Brush it all over with the liquid jam and lift the cake on to it. Press the paste firmly round the cake against the sides and on the top, but do not cover the ends.

Decorate the top edges by pinching with thumb and finger. Cover with greaseproof paper and leave to stand for a day or two before use. Then either mark out in a trellis pattern with a knife or decorate by forcing strips of coloured butter icing over it.

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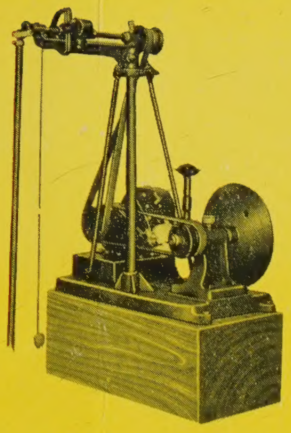

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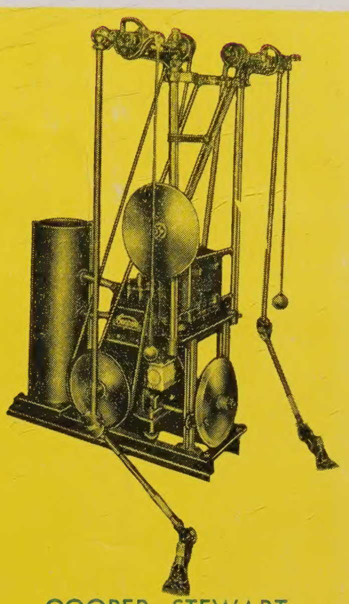

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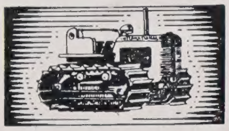

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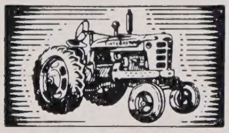

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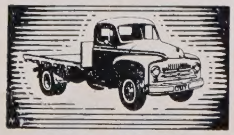

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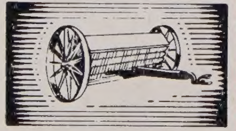
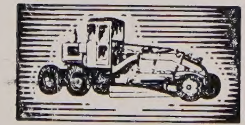


FROM SWEDEN

Fertilizer Distributors



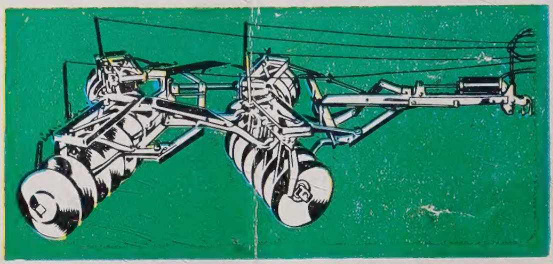
FROM NEW ZEALAND

Tandem Graders, Angledozers, Loader Dozers, Wheel Loaders, Patrol Graders

McCORMICK INTERNATIONAL TILLAGE TOOLS

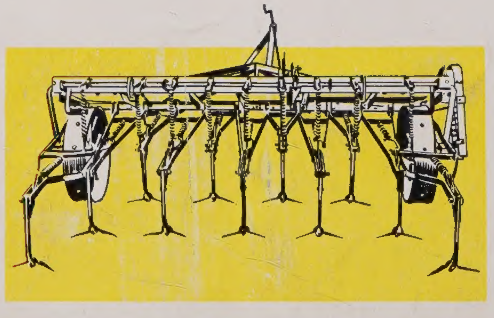
GL9A TRACTOR DISC HARROW

Thorough, more complete discing of ridges and effortless simplicity of operation — these are what you get in the GL9A. The exclusive CROSSED-DRAFT FRAME design* gives quick angling, accurate trailing, even when turning or on uneven ground. Whatever the surface, the rear discs cut out the ridges formed by the front gangs. GL9A Discs are of advanced CRIMPED-CENTRE design. Besides giving added strength, this shape allows closer fit to the spools, more uniform, more rugged gang assembly. Heat treated, they hold their cutting edge unusually long.



Farmall Hydraulic Remote Control equipment is available for use with the GL9A. And HYDRAULIC ANGLING on the move speeds work; effortless operation from driving seat.

** Drive the tractor forward — gangs lock at pre-selected angle. Back up, they straighten. Angles simply adjustable for varying conditions. The GL9A comes in 5, 6, 7, 8, and 17ft. sizes, the 18in. discs spaced 6⅝in. apart.*



F8A FIELD CULTIVATOR

CLOSER FENCELINE WORK is now possible with the F8A. Design changes allow end tynes to dig beyond wheel span. Both 11 and 13 tyne sizes can cover more ground per run. That means fewer runs, less time on the job.

The F8A, built for speedier, tougher tractor operation, enables early and persistent cultivation against noxious weeds. The F8A helps combat erosion. With deep clods raised, valuable topsoil works down away from wind and rain. Better seedbeds are possible with F8A. Big clods are broken and the soil stirred deeply, allowing air to circulate. Uncluttered design and wide tyne spacing eliminates blockage delays. Stiff tyne gangs incorporate automatic trips — no obstruction damage. 10in points, depth regulator and power lift standard equipment.

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GL9A TRACTOR DISC HARROW

(Tick implement concerned.)

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